

The Mining industry in that
part of northern Ontario
served by the Temiskaming
and Northern Railway
1912

W. H. STICKLER



Temiskaming and Northern Ontario Railway Commission

THE
MINING INDUSTRY

In that Part of

NORTHERN ONTARIO

Served by the

Temiskaming and Northern Ontario Railway

ONTARIO GOVERNMENT RAILWAY

SIR JAMES P. WHITNEY, PREMIER

CALENDAR YEAR 1912

By ARTHUR A. COLE
Mining Engineer

PRINTED BY ORDER OF
THE LEGISLATIVE ASSEMBLY OF ONTARIO



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To His Honour Sir John Morison Gibson, K.C.M.G.,
Lieutenant-Governor of Ontario.

MAY IT PLEASE YOUR HONOUR:

The undersigned has the honour to present to Your Honour Report of the Mining Engineer on the Mining Industry in that part of Northern Ontario served by the Temiskaming and Northern Ontario Railway for the calendar year 1912.

Respectfully submitted,

J. O. REAUME,

Minister of Public Works.

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HON. J. O. REAUME,
Minister of Public Works,
TORONTO, ONTARIO.

SIR,—I have the honour, by direction, to submit to you, Report of the Mining Engineer on the Mining Industry, in that part of Northern Ontario served by the Temiskaming and Northern Ontario Railway, for the calendar year 1912.

I have the honour to be,

Sir,

Your obedient servant,

A. J. McGEE,

Secretary-Treasurer.

TEMISKAMING AND NORTHERN ONTARIO
RAILWAY COMMISSION.

J. L. ENGLEHART, Chairman.

DENIS MURPHY, Commissioner.

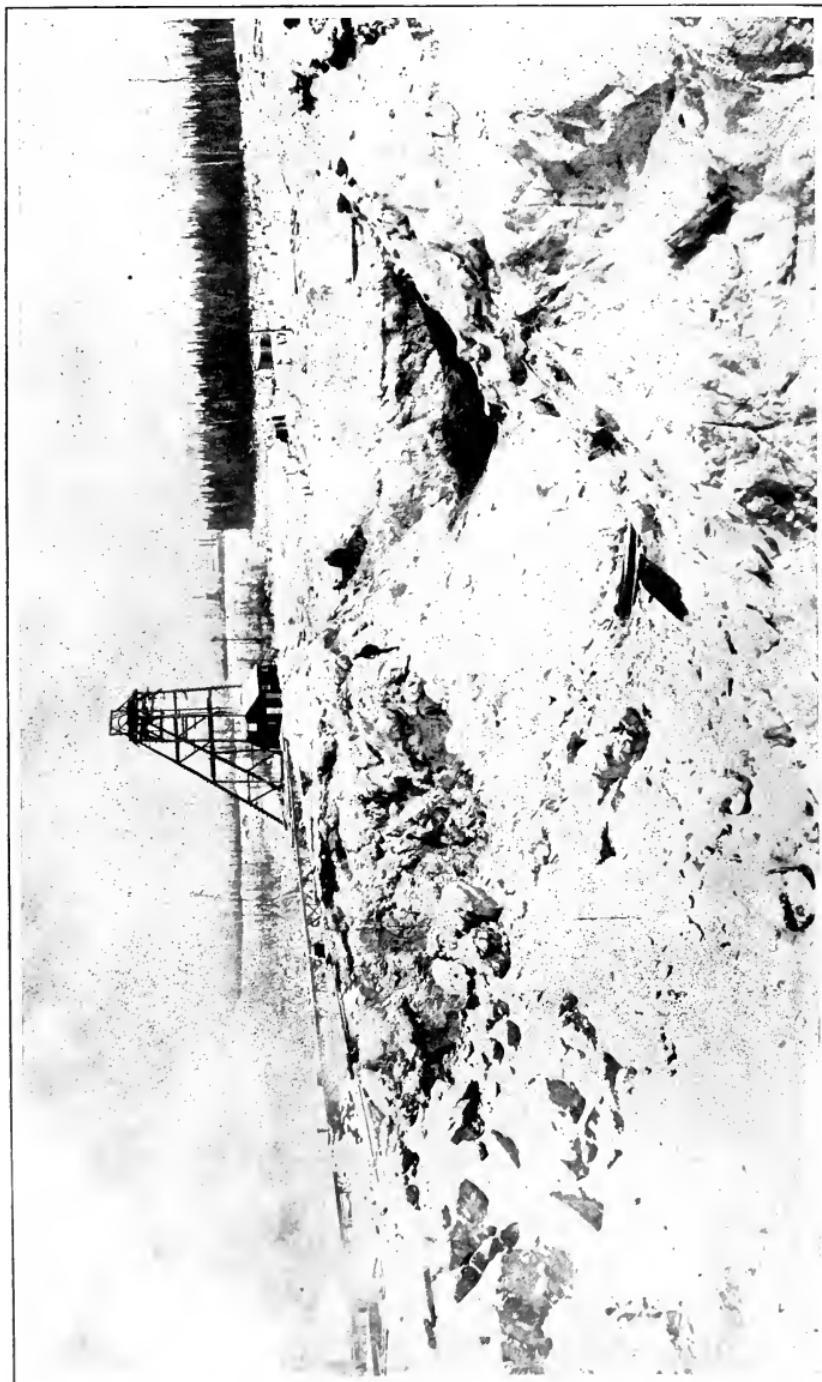
FRED. DANE, Commissioner.

A. J. MCGEE, Secretary-Treasurer.

A. A. COLE, Mining Engineer.

ERRATA:

Page 12, 4th line from bottom, "contracts" should read "contacts."
Page 12, 6th line from bottom, "chist" should read "schist."
Page 15, 16th line from top, "chist" should read "schist."
Page 18, top of page, "Lots 10-11, Con. 11," should read "Lots 10-11, Con. II." (2).
Page 20, top of page, "bassalt" should read "basalt."
Page 33, Ore Shipments, total for 1912, 26,631.79 tons, should be 21,631.79 tons.
Page 27, "Spencer-Superior" should read "Seneca-Superior."
Page 59, "Reverberating" should read "Reverberatory."
Page 61, "Reverberating" should read "Reverberatory."
Page 70, "Centrator" should be "Concentrator."
Page 75, Copper, net value, \$1,1, should read \$1,133.



"Glory Hole," or Open Cut, looking towards Dome Extension. Dome Mine, Porcupine, Ont.

Copyright, Canada 1913,
by Arthur A. Cole.

GOLD.

PORCUPINE.

The occurrence of gold in Northern Ontario has been known for many years, but the few mines that did pay for a time, only strengthened by their early failure, the belief that gradually spread throughout the country, that gold mining in Ontario must necessarily prove unprofitable. This idea will account for much of the scepticism that greeted the news of gold finds in Porcupine in 1909. Fortunately for the district, the largest finds early passed into the hands of strong financial interests that insured their thorough testing and development. Lack of adequate transportation facilities retarded the opening up of the new camp in 1910, but good progress was beginning to be shown in 1911.

The Temiskaming and Northern Ontario Railway built a branch line 33 miles from the main line to serve the district. The construction of several mills was well under way when the disastrous fire of July 11th. 1911, swept through the country, not only causing the destruction of these mills, along with most of the mining plants on the ground, but also entailing a large loss of human life. Construction, however, was immediately recommenced with the result that Porcupine became a regular producer early in 1912. The estimated value of the gold output for the year is \$1,800,000. The actual gold production from the district as given by the Ontario Bureau of Mines is as follows:

Year.	Ore treated tons.	Gold Bullion. Ozs.	Value.
1910	1,060	1,947	\$35,539 00
1911	707	851	17,187 00
1912	88,466	50,633	1,032,313 00
(9 months)	90,233	53,431	\$1,085,039 00

The small productions shown for the years 1910 and 1911 came from the small experimental plants on the Hollinger, Dome and Vipond, but all three were destroyed by the forest fires of 1911.

The new mills that have since been erected and are responsible for the 1912 production are:

1. Dome.
2. Hollinger.
3. McIntyre.
4. Vipond.

while those now under construction are:

5. Dome Lake.
6. McEnaney (Crown Reserve Mining Co.)

and the new mill of the McIntyre.

The first company to declare a dividend was the Hollinger, which on the 2nd November paid 3 per cent., or a total of \$90,000. In a statement to the shareholders, the President of the Company states:

"Our profits at the present time are over \$10,000 per week, and the management is confident of continuing this at an undiminished rate, hence the payment of regular dividends every four weeks present no difficulties, and will permit concurrently therewith substantial increases to be made to the reserve fund of the Company."

The third dividend was paid on the 31st December, making a total dividend disbursement for the year of \$270,000.00.

In November labor troubles arose which closed down some properties and interfered for a time with the efficient operation of most of the others, but by the end of the year conditions were again approaching a normal state.

Mining:

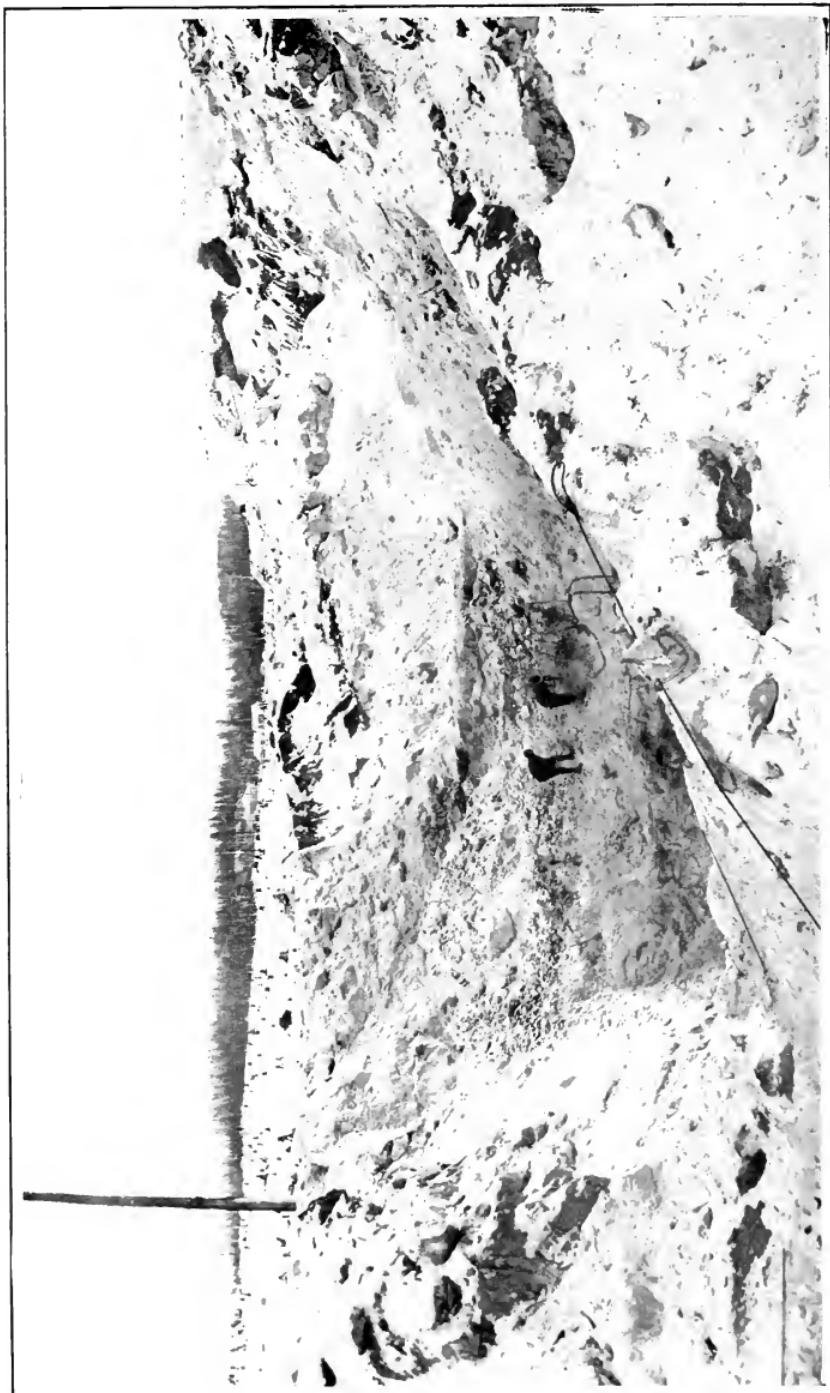
Winning the gold at Porcupine presents no very novel difficulties to overcome, so the modes of mining used are the standard methods adopted on somewhat similar conditions in different parts of the continent. Two different types are exemplified in the Donie and the Hollinger, the former using the "Open-cut" or "Glory Hole" method, and the latter, the regular underground method, with the "Shrinkage stope" system. In both systems the initial work is usually similar. After the timber is cleared off, the surface is striped or trenched to locate the veins. Vertical shafts are then sunk at suitable points, and levels are opened up, usually at 100 foot levels, though intermediate levels are sometimes run for local reasons. Reciprocating air piston drills are used, the favorite size being the 3 $\frac{1}{8}$ -inch machine. Except when the stopes are wide, the small hammer drills have come into very general use for stoping.

In some shaft sinking recent practice favors the adoption of small plunger drills in preference to the heavier reciprocating piston drills. The advantages claimed for the plunger drill are:

1. Lighter and therefore more easily handled, hoisted or lowered.
2. Only three men are required to handle two machines, instead of four men for two of the piston machines.
3. Time taken to set up and tear down the larger machines is saved, and the actual drilling time is thus increased.
4. A greater footage of drilling is even claimed for the smaller machine in a given length of drilling time.
5. Fewer holes can sometimes be used to break a round, by drilling a few holes at a time, and then blasting. Advantage can thus be taken of any peculiarities in the breaking of the rock. If this method were tried with the heavier machines, too much time would be consumed in setting up and tearing down.
6. Small consumption of compressed air.

In the harder ground and particularly in the solid quartz the piston drill is still used for sinking on account of the large number of steel breakages (due doubtless to crystallization) and the consequent loss of holes.

Timbering employed is very simple. Square sets are used in the shafts. Stulls and lagging are placed in the stope above the drifts and the ore is broken down onto the timber by overhand stoping. Work is carried up on the broken



Open Cut, looking towards Preston East Dome, Dome Mine, Porcupine, Ont.

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by Arthur A. Cole.

ore, only sufficient being drawn off below through chutes to keep the broken rock far enough away from the back to allow work to proceed.

At the Dome Mine a different method of mining is adopted as described under the mine heading.

Milling:

Most of the ore on the surface was free-milling, but as the workings went down the gold was found to be more closely associated with the sulphides and simple amalgamation had to be augmented by cyanidation.

Primary grinding of the ore is performed by stamps in all cases, except in the Vipond mill, where rolls are employed to follow the crushers.

The Hollinger mill is a cyanide plant, while at the Dome preliminary amalgamation is employed before cyanidation. By the use of coarse screens the stamp duty is run up to 10 tons or over per 24 hours.

Power:

Two hydro-electric power plants belonging to the Northern Canada Power Company have been installed on the Mattagami River to supply power to the Porcupine gold district.

The first is situated at Sandy Falls, six miles north-west of the Hollinger Mine, or eight miles from Timmins Landing, down the Mattagami River. The installation consists of two pairs of 43-inch turbines, rated at 1,700 horse-power, with a 34-foot head, and two generators of 1,500 horse-power each, 25 cycle, 3 phase, 12,500 volt, 214 r.p.m. Foundations for a third unit of 1,500 electrical horse-power have been prepared, and this addition to the plant can be made whenever required.

The second plant at Wawayan Falls, also on the Mattagami River, is situated eleven miles south-west of the Hollinger Mine, or about 20 miles by river. The plant consists of two turbines designed to produce 3,450 horse-power each, under a 110 ft. head. Each turbine operates a Westinghouse generator at 2,500 h.p. built to sustain an overload of 50 per cent.

The cost of power to the mines is \$50.00 per horse power per annum, calculated on peak loads.

The year's operations in the district have been highly satisfactory. Development has in almost every case bettered the physical conditions of the properties that had anything like fair prospects to start with.

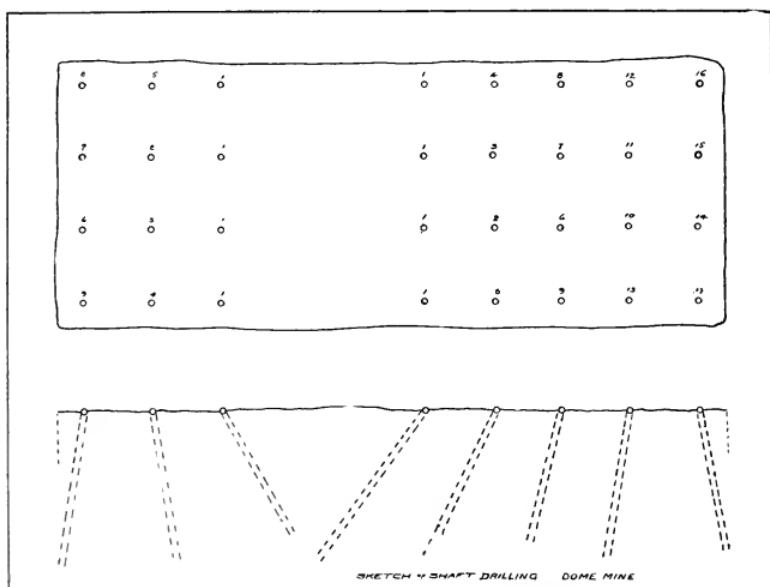
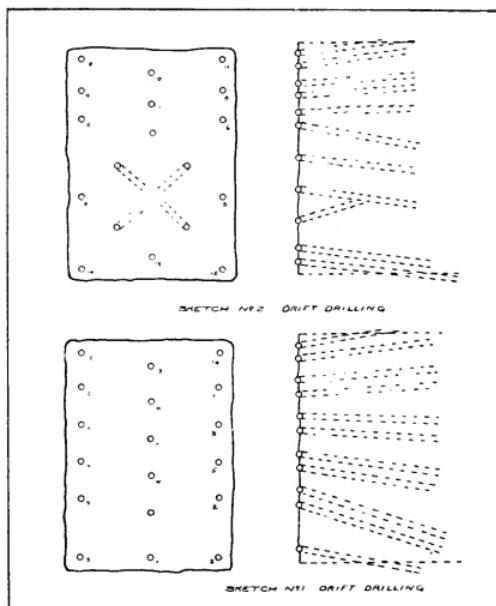
THE DOME MINES COMPANY LIMITED.

The property of this Company consists of 240 acres of mining lands situated in the south-eastern part of the township of Tisdale.

The ore consists of large masses of quartz and chist, frequently alternately banded and much mixed. The presence of quartz seems to be a necessary accompaniment of the gold values, though it is rather along the small contracts of the quartz and schist that the gold occurs, than in the quartz itself. The ore is, however, so mixed that very little sorting can be done, and the whole mass is sent to the mill if the average is of milling grade. Two 3-compartment vertical shafts



Mixed Quartz and Schist, 45-foot Level. Copyright, Canada 1913.
Dome Mine, Porcupine, Ont. by Arthur A. Cole.



Methods of Drift and Shaft Drilling.
Dome Mine, Porcupine, Ont.

have been sunk, No. 1 to 100 ft., and No. 2 to 250 ft. Sinking of No. 2 shaft is to be continued. A double tracked incline 568 ft. long connects the 45 ft. and the 100 ft. levels with the surface, and the mill. From the surface to the 15 ft. level the grade is 13.55 per cent., and from the 45 ft. level to the 100 ft. level, 18.19 per cent.

The 45 ft. level was divided into 100 ft. rectangular blocks of ore by drifts and crosscuts. A number of raises were then run to the surface with a chute at the foot of each. The ore which was broken down from above in benches was drawn off through these chutes, trammed by mules to the foot of the incline and hoisted into the mill. As the ore is mined and drawn off, inverted cone-shaped excavations are formed. Fourteen of these open pits are gradually running together, making one large open pit or "Glory Hole." No timbering is done except in shafts and chutes.

Piston drills are used underground for drifts, crosscuts and shafts; hammer drills for raises, and small pluggers and piston drills for stopes.

In drifting in the chist it requires 17 to 18 holes 6 ft. deep to bring the round. The bottom cut is generally used as shown in sketch No. 1. In some of the drifts where the ground is blocky the four hole diamond cut (sketch No. 2) is used to advantage. The average drilling per shift is from 8 to 9 holes.

In drilling in the quartz, the same number of holes is used, but six to seven 5-ft. holes is a shift's work. The average amount of powder used per round is 150 sticks, 50 of this being gelignite used in the cut and the remainder 10 per cent. dynamite for the square up. The machine used is the Rand 3½ inches.

In the glory hole stoping six plunger drills (Rand BC 26) are used to break ore for the mill. The average footage drilled per machine is approximately 56 ft. The powder consumption averages about 8 sticks per hole of C.L.X. Special, the holes having an average depth of 8 ft.

Sketch No. 3 shows the method of placing the holes in a sinking round.

The total underground workings now amount to nearly 1¼ miles, without counting shafts and raises.

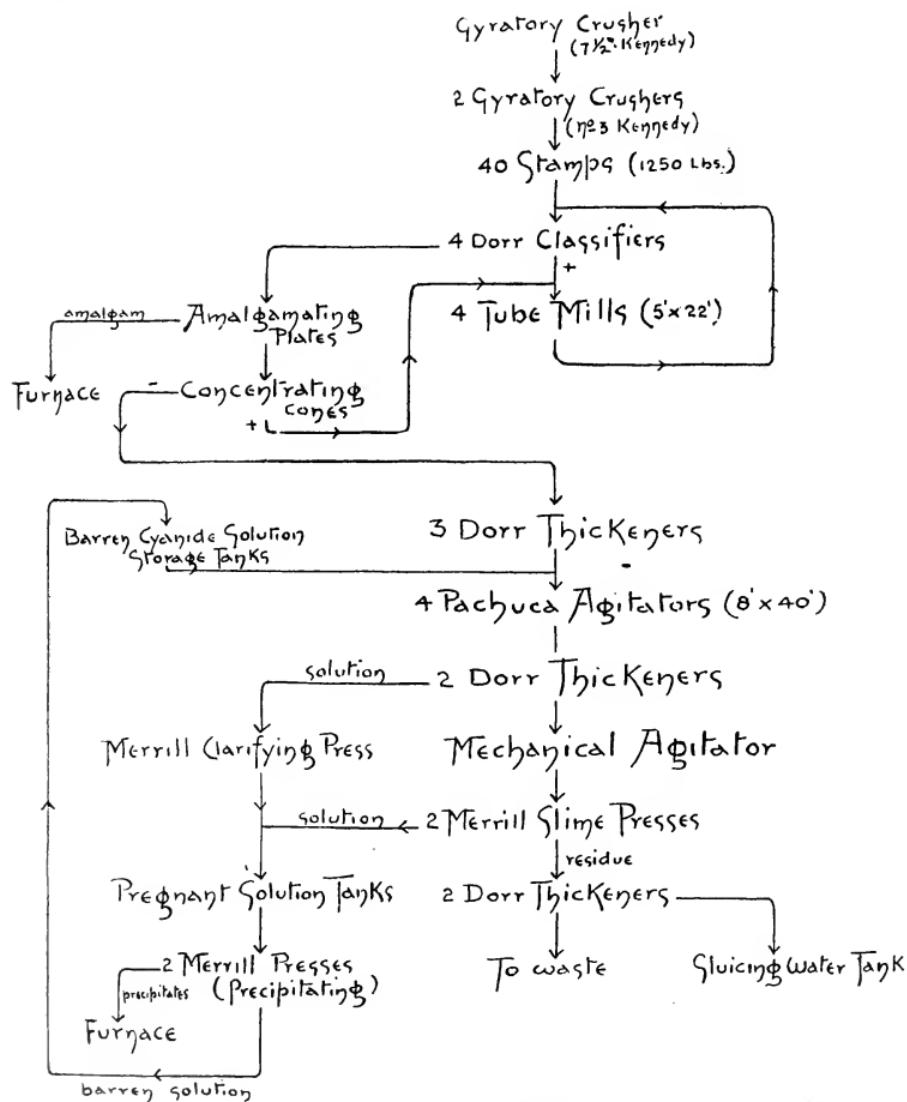
A 75 h.p. geared electric hoist serves the inclined shaft while a similar hoist of 250 h.p. capacity is installed at No. 2 shaft. At present, power is supplied by seven 150 h.p. Babcock & Wilcox boilers, fired with soft coal. Two 375 K.W. Allis-Chalmers generators run by 2 Robb-Corliss engines give the required electrical power for operating the mill, hoists, etc., and two 12-drill Ingersoll-Rand air compressors supply the mine with the necessary compressed air.

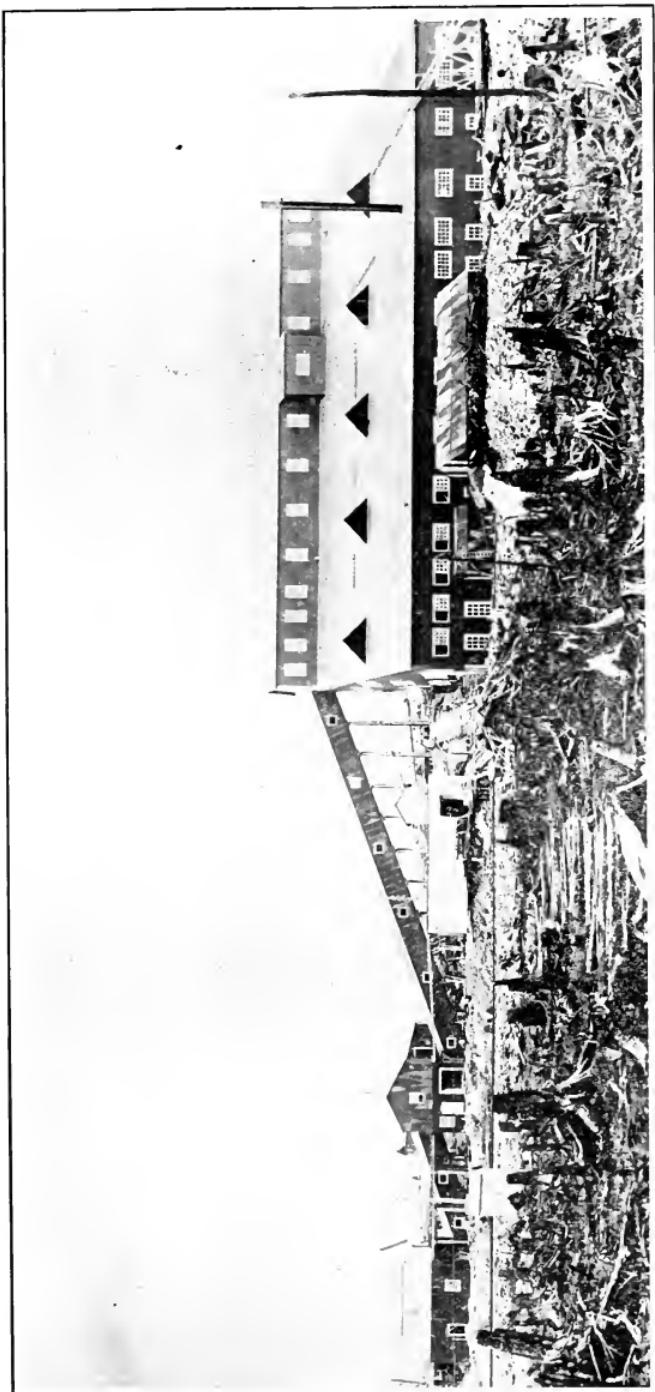
Instead of generating electrical power by coal, it will be bought from the Northern Canada Power Company as soon as the plant at Wawaian Falls is operating.

The mill is a steel frame structure with concrete foundations and floors. The crusher plant is on the ground level and is housed in a separate building from the mill proper to which it is connected by an inclined belt conveyor way.

The flow sheet following shows in outline the method adopted in the mill for the extraction of the gold.

From the 23rd March, when the mill started, to the 1st November, the mill treated 65,000 tons. The average daily tonnage now treated is 333 tons. A new tube mill and presses are being installed which will run the capacity up to 425 tons daily, and further enlargements are under consideration.





Donne Mill (40 Stamps), Porcupine, Ont.

HOLLINGER GOLD MINES.

This company owns four 40 acre lots in the south-west of the Township of Tisdale, in lots 10 and 11, Con. 11.

A large number of quartz veins have been located on the property, but 41 are definitely known to carry payable gold values. Only 8 of these have had any development work on them yet, as is shown in the following statement:

Total Development to Oct. 5th, 1912.

100 ft. level.	Length.	Av. Width.	Av. Value.
No. 1 vein.....	1,000 ft.	8 ft.	\$31 54
.. 2	665 ..	5.2 ..	12 50
.. 3	136 ..	4.4 ..	5 60
.. 4	485 ..	8.2 ..	12 91
.. 8	56 ..	5.2 ..	4 90
.. 37	70 ..	4.6 ..	11 60
.. 38	66 ..	3.8 ..	15 30
200 ft. level.			
No. 1 vein.....	839 ..	6.7 ..	45 74
.. 2	42 ..	6.2 ..	10 60
.. 4	125 ..	5. ..	9 20
.. 37	155 ..	4.2 ..	10 80
.. 41	57 ..	4.5 ..	15 10
300 ft. level.			
No. 1 vein.....	63 ..	5.7 ..	8 40
.. 2	x	13. ..	16 00
.. 37	x	4. ..	20 00

x Exposed by crosscuts.

The veins occur either in a porphyry schist or near the contact. So far development has been confined to veins in the porphyry. The strike of the schist is generally south-west to north-east, while the quartz veins cut across this strike at a small angle more to the north and south.

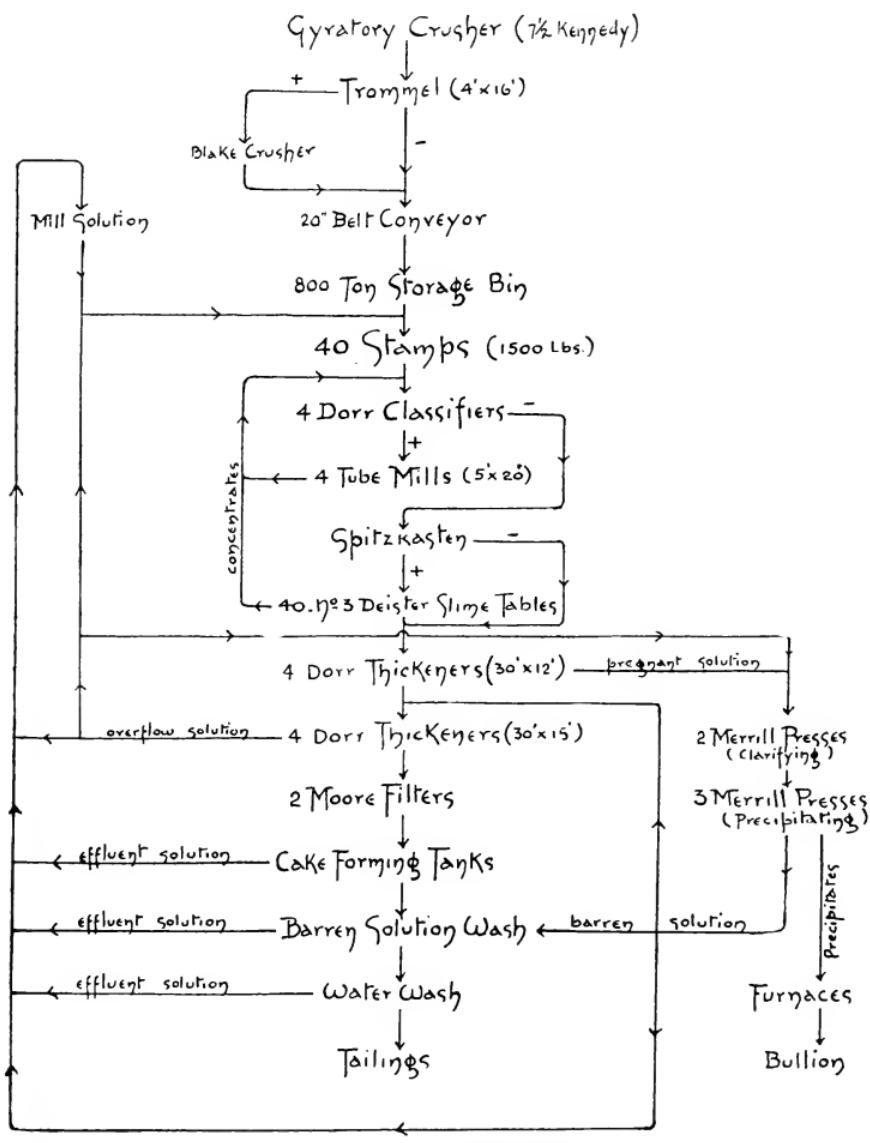
No. 1 vein, which has had most development, has a characteristic lenticular structure varying in width from 20 down to a few feet, the lenses frequently overlapping.

During 1910 a small steam two-stamp Tremain mill with a daily capacity of about 4 tons, ran preliminary tests on the ore, and demonstrated the richness of the ore being mined.

A modern mining and milling plant has now taken the place of the prospecting plant which was practically all lost in the fires of 1911.

The mine is being opened up by levels 100 ft. apart, the lowest at present being the 300 ft. The main 4-compartment shaft only goes to the 200 ft. level, but work will soon be resumed to connect it with lower levels. A winze connects the 200 ft. and 300 ft. levels. Underground workings, including drifts, crosscuts, shafts and winzes now aggregate over 1½ miles.

The following table will give an idea of the drilling averages in the different rocks at this mine. The drifts will average about 6 ft. x 7½ ft., and the machine used is a No. 43 Rand-3½ inches:



FLOW SHEET, HOLLINGER MILL.

Rock.	Holes.		Powder 1-1 4.		Depth broken ft.	Time hours †
	No.	Depth, ft.	No. sticks.	Description.		
Quartz and schist in porphyry..	15	5	130	40% dynamite.....	4.0	14
" " bassalt ..	14	5	110	" ..	4.5	10
" alone.....	19	5	160	" ..	3.5	18
Schist with dip.....	12-14	5	90	Some gelignite in cut ..	5.0	15
Schist against dip.....	15	5	115	40% dynamite.....	3.75	18x

x 3 hours lost and 15 sticks of dynamite used in reblasting cut.

† This time includes drilling, shooting and setting up.

In stoping when the ore is 20 ft. wide as is frequently the case in No. 1 vein, the ore is broken down in benches by long almost flat holes, piston drills being used.

32 holes, 7 ft. deep are employed to break a block of ore 20 ft. x 10 ft. x 7 ft., using from 6 to 7 sticks of powder per hole.

The average value of all ore removed from the mine to the 5th Oct., 1912, was \$23.69 per ton, established by treating 26,221 tons in the original test mill and in the new mill. This amount was made up of waste rock inadvertently included from drifting and sinking, but showed an average value of \$19.70 per ton, while the remaining 5,777 tons of ore from the stopes showed an average value on treatment of \$37.89 per ton.

During 1912 the company milled a total of 45,195 tons, producing therefrom:

	Bullion.	Value.
	ozs.	
Gold	43,689.52	\$903,062 46
Silver	9,756.33	6,119 07
Totals.....	53,445.85	\$906,181 53

The above values are for bullion produced, and not the total value of the ore treated. There is probably \$60,000 in precipitates on hand and mill solutions, so that the total value of the ore milled was approximately \$970,000.00.

The new mill is treating, on an average, 300 tons daily, with 30 stamps working, making 97 per cent. extraction from \$30.00 ore. With the 40 stamps in operation the capacity will reach from 450 to 500 tons per day as the stamp capacity has been tested up to 12 tons per stamp per day. The cyanide plant has a maximum capacity of 600 tons per day.

Under normal working conditions the company makes a weekly profit of \$40,000.00 and it is from this that it is paying its four-weekly dividend of 3 per cent., or \$90,000.00.

DOME LAKE MINING AND MILLING COMPANY.

This company owns three patented claims in Lot 6, Con. 1 of Tisdale.

Four shafts have been sunk with a maximum depth of 180 ft., and about 1,500 ft. of drifting and crossecutting run.

The ore bodies encountered average between 4 and 5 feet, and are considered sufficiently high grade to warrant the erection of a small 10-stamp mill. This mill is now nearing completion, and is equipped with 1,050 lb. stamps, one 5 ft. x 18 ft. tube mill, and 4 concentrating tables. The capacity will be about 50 tons of ore per day. The values will be recovered by amalgamation and in concentrates at present, but the addition of a cyanide plant is probable later.

JUPITER MINES.

This property contains approximately 80 acres on the north of Pearl Lake in the Township of Tisdale.

Underground workings have attained a depth of 300 ft. and over 4,000 ft. of drifting and crossecutting completed.

Good ore has been developed on every level but on two of the upper levels, some difficulty was experienced with faults. On the 300 ft. level the ground is more settled. A sufficient probable tonnage has been developed to warrant the erection of a mill, and this will likely be undertaken in the spring.

MCENANEY MINE.

This mine is owned and operated by the Crown Reserve Mining Company of Cobalt.

The property consists of one 40-acre claim adjoining the Hollinger on the south.

A 2-compartment vertical shaft has been sunk 417 ft., with levels every 100 ft.

Good ore shoots have been located on each of the levels, with an average width between 3 and 4 feet, and an average value over \$20.00.

A small mill is now nearing completion. It has 5 stamps installed and foundations ready for another 5. A tube mill will be used for regrinding, and all recovery will be by plate amalgamation. A cyanide plant is to be added later.

MCINTYRE PORCUPINE MINES.

The company's holdings comprise 148 acres, being 52 acres between Pearl and Gillies Lakes, 28 acres of the bed of Gillies Lake, and 68 acres of the bed of Pearl Lake.

A 10-stamp mill started operations on March 1st, 1912, and by the end of the year it had treated 14,500 tons of free milling ore. The method of recovery is simple plate amalgamation. It was found that the percentage of sulphides increased in the ore so rapidly with depth that the extraction by plate amalgamation and concentration was not satisfactory. It was therefore decided to erect a mill using straight cyanidation and a 300 ton mill was started. The first unit of 150 tons is now nearing completion, and work will be immediately started on the second unit.

PEARL LAKE GOLD MINES.

This property consists of three claims and a fraction, with a total area of 122 acres, situated between Pearl Lake and Gillies Lake. Three prospecting shafts have been put down to a little more than 100 feet each, but the work is now

confined to the main shaft which is now down 635 ft. This shaft has 3 compartments, and is vertical, and levels have been opened at 400 ft. and 600 ft. depths. On the 400 ft. level ore was encountered 226 ft. to the south of the shaft and the ore chute was opened up 75 ft. each way, giving an east and west ore chute of 150 ft. in length. In the east drift the ore is cut off by a fault. On the 600 ft. level a crosscut is being driven to cut the vein. A 30-stamp mill is to be installed in the spring.

PLENAURUM MINES.

This property is situated to the east of the Jupiter, to the northeast of Pearl Lake, in the township of Tisdale.

Two shafts are down 200 ft., at which level most development work has been done. The main crosscut runs north-west across under the east end of Pearl Lake, and cuts most of the veins at right angles. A winze from the 200 ft. level has reached a depth of 60 ft. all in good ore.

Exploratory work is proceeding on 9 ore-bearing veins on the 200 ft. level.

VIPOND PORCUPINE MINES.

The main shaft is 347 ft. deep, and levels have been opened up at 100 ft., 200 ft., and 300 ft. In sinking, plunger drills are used with a rose bit and hollow steel.

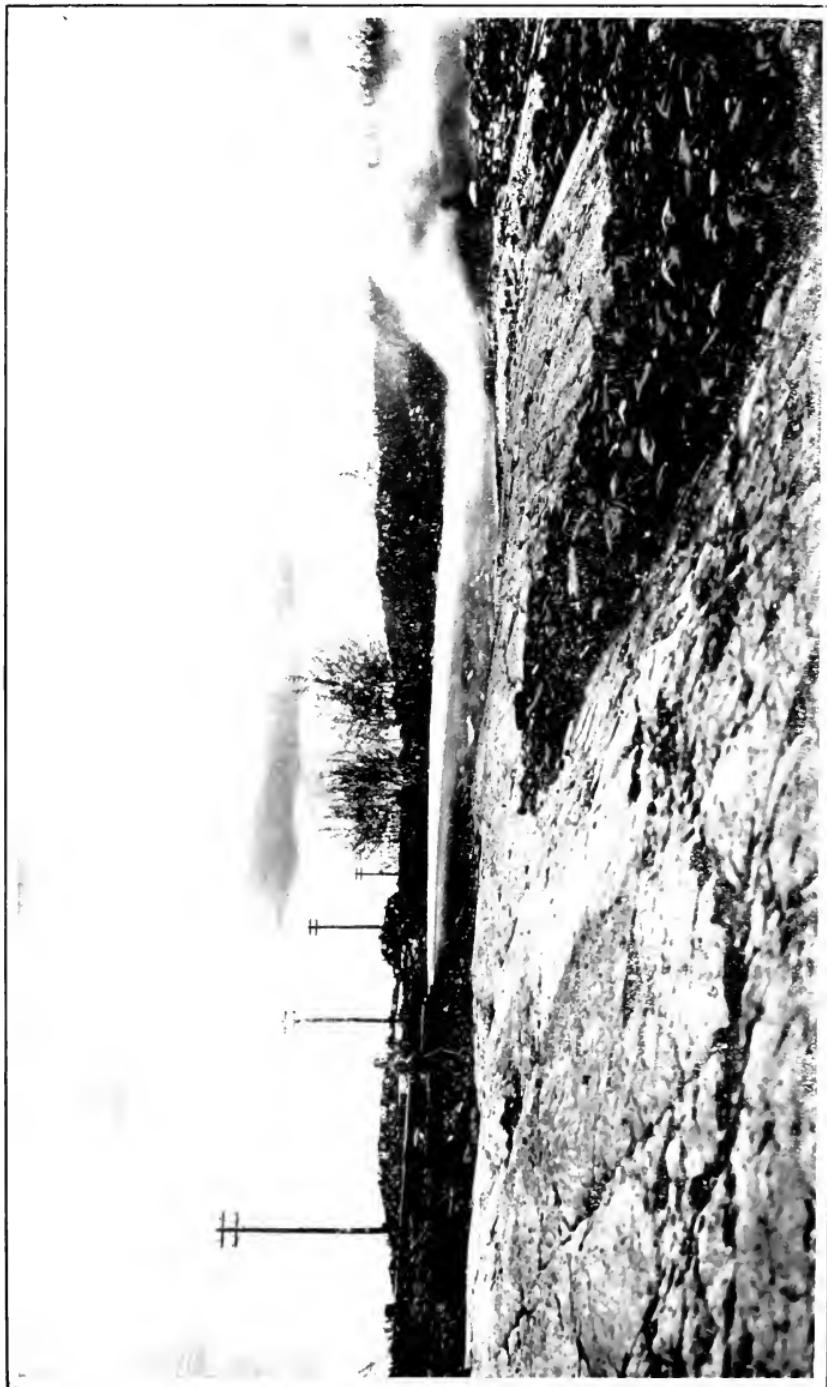
The mill has a daily capacity of 100 tons. It started operations on the 7th July, and had treated 6,000 tons by the end of October, when it was closed down for alterations.

The mill is equipped with jaw crusher, Sturtevant rolls, Hardinge ball and pebble mills, and Colbath classifiers. The ore is crushed to 200 mesh and amalgamated on plates. It was found, however, that this only gave an extraction of about 60 per cent., so that the mill has closed down temporarily till a cyanide plant can be added.

Swastika.

Work has been continued at the Swastika and Lucky Cross Mines, and these companies now consider that they have enough ore blocked out to warrant the erection of small mills. A 10-stamp mill for the Swastika and a 5-stamp mill for the Lucky Cross are now nearing completion.

Considerable interest is being shown in the district surrounding Kirkland Lake, to the north-east of Swastika. The principal property, known as the Tough-Oakes Claim, is now being opened up by Clement A. Foster. The property consists of five claims aggregating 185.6 acres. The claim on which the work is now being done is in the township of Teck, close to the Lebel line, 7 miles north-east of Swastika. Five veins have been located but it is the No. 2 vein that is now supplying the ore. Two shipments have been made from an open cut on this vein. The first shipment consisted of 52 bags weighing 3,785 lbs., and assaying 18.6 ounces gold per ton. The second shipment which went to the smelter in January, 1913, weighed 19.77 tons, and assayed 22.509 ounces gold per ton, or a total gold content of 115.16 ounces. This No. 2 vein has been opened up for a length of 450 ft., but the ore has been taken from an open cut 55 ft. long and 14 ft. deep. The veins though narrow appear to be very persistent, and sometimes values are also found in the walls. The wall rock is a conglomate, but



Hydraulic Prospecting on Nipissing Hill by Nipissing Mining Company, Cobalt, Ont.

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by Arthur A. Cole.

is not far from a mass of feldspar-porphyry, which is probably the source of the gold, or at least the cause of the introduction of the gold. A 5-stamp mill has been ordered and is expected to be delivered at the mine in good time before the break-up. The mine is reached at present by a good sleigh road from Swastika Station.

The other most noteworthy properties in this district are the Oakes, the Hughes and the Costello. The country has been staked for miles around, and there are many prospectors in the district, and development has been quite encouraging.

Larder Lake.

One property, the "Goldfields Limited" re-started operations in the latter part of the year, on the completion of its 30 stamp mill. This is the only operating mill in the Larder Lake district. It derives its power from the company's own hydro-electric installation at Raven Falls, to the south-east of Larder Lake.

Good reports are coming in from the township of Gauthier, and one plant is going in over the winter road.

SILVER.

The silver industry still easily holds the premier position among the mining industries in that part of Northern Ontario served by the Ontario Government Railway.

The outstanding feature of the year 1912 has been the remarkable revival of interest in silver properties in the district, manifested in the reopening of a number of claims that had been worked for a while in the infancy of Cobalt, and later closed down on account of the indifferent success met.

The finding of a high grade vein on the 200 ft. level of the Seneca-Superior under Cart Lake doubtless had some influence on this revival. The sensational change also in the fortunes of the Cobalt Townsite Mining Company, one of the few Cobalt companies financed by English capital, from deep indebtedness to a highly remunerative dividend basis, and the bonanza silver find made on the lower levels of the sister English company, the Casey Cobalt Mine, also had a marked effect. Another discovery that is likely to have far reaching effects in the future is the location of good ore in both the Temiskaming and Beaver properties in the diabase below the Keewatin.

Cobalt will likely show a falling off of a million ounces in production for 1912, compared with 1911, but with the increased value of silver during the year, the total value will likely show an increase of about two million dollars, or 18,000,000. Under normal working conditions the present indications point to a decided increase in the output for 1913 over that of 1912. When the fact is considered that most of this production comes from Cobalt proper, or from an area of about six square miles in extent, in the township of Coleman, and "when it is considered that the geology of this area is similar to that of numerous other areas in several of which either cobalt, or cobalt and silver, have been found, it may reasonably be expected that in a region approximately 5,000 square miles in extent important discoveries will be made in localities that at present are unproductive."

—Dr. W. G. Miller, in the *Canadian Mining Journal*, Feb. 1st 1913.



Copyright, Canada 1913, by Arthur A. Cole.
Silver Vein discovered in 1912. Average assay 5,000 ounces Silver per ton, 4 inches wide; length of ore shoot, 250 feet. Casey Cobalt Mine, Casey Township, Ont.

Isolated productive mines have been found outside of Cobalt, such as the Casey, 19 miles north of Cobalt, the Wettlauf, 20 miles south, and the Miller Lake-O'Brien of Gowganda, 50 miles north-west, but there must still remain in that 5,000 square miles many six-mile areas that are practically unprospected, and consequently cannot be said to be barren. The year's work also proves that intensive prospecting in the areas already fairly well known may be productive of excellent results.

In the actual operation of the silver mines, the ceaseless search for still more economical methods of mining and treatment goes on. Concentration takes a still more important place than formerly in the treatment of the low grade ores. The advance in the metallurgical treatment of the ore is seen in the increased shipments of refined silver bullion, with a corresponding decrease in the ore shipments to the smelters. The high grade mill of the Nipissing was in continuous operation during the year, and the Buffalo Mine came into line with a similar mill towards the end of the year.

SILVER PRODUCTION OF THE WORLD.*

(In fine ounces.)

—	1911	1912
Mexico	79,632,440	76,500,000
United States.....	60,399,400	62,369,903
Canada.....	32,740,748	35,250,000
Australasia.....	16,578,421	17,950,000
Other Countries.....	36,621,835	37,500,000
	225,372,844	229,569,903

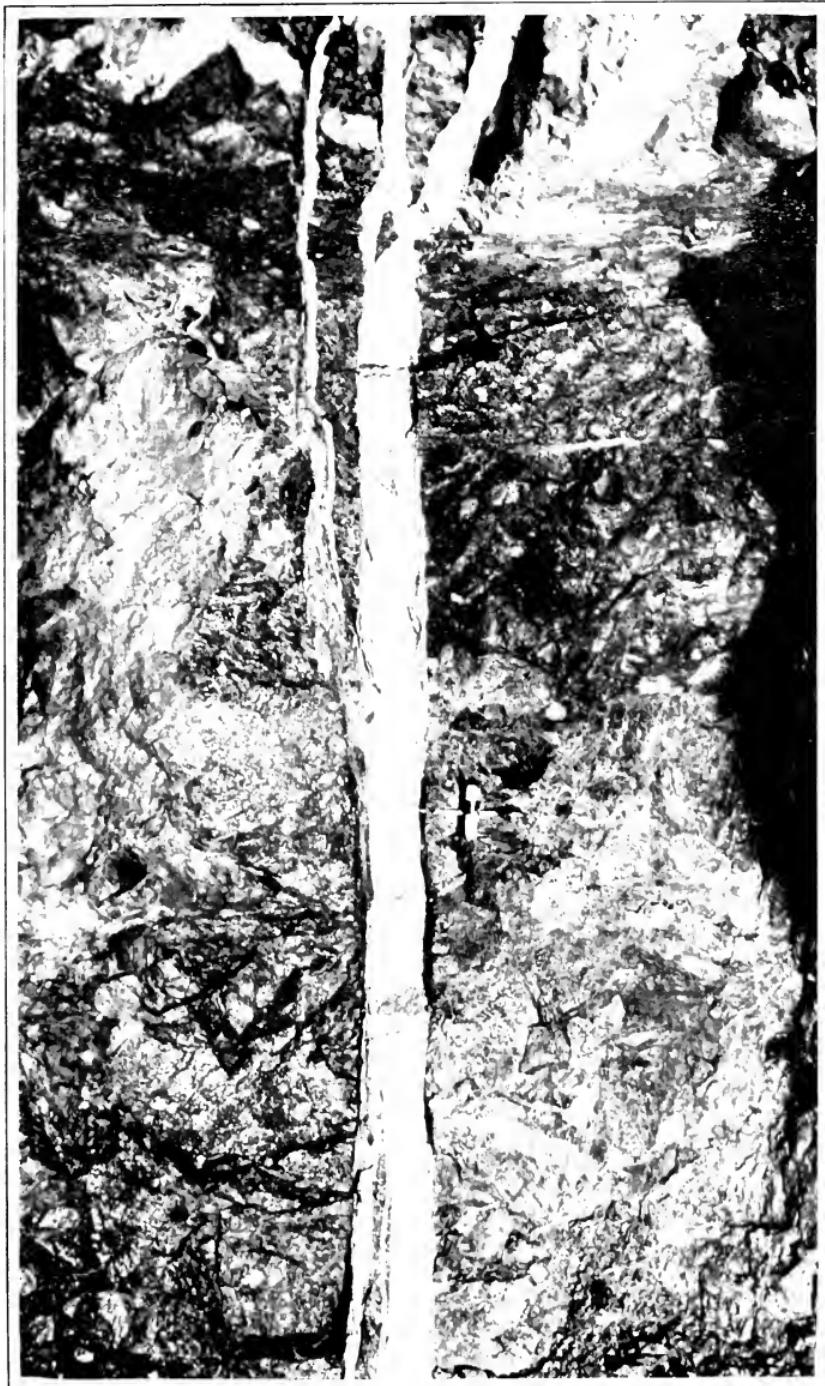
Canada still occupies third place in the world's production of silver, with an output of 35,250,000 ounces, or over 15 per cent. of the total. Of this Cobalt produced about 30,500,000 ounces, or over 13 per cent.

The silver market throughout 1912 was strong, and advancing, with occasional slight reactions only. The average monthly prices in New York are shown below.

MONTHLY AVERAGE PRICE OF SILVER.

Month	1910	1911	1912
January	52,375	53,795	56,260
February	51,534	52,222	59,043
March.....	51,454	52,745	58,375
April.....	53,221	53,325	59,207
May.....	53,870	53,308	60,880
June	53,462	53,043	61,290
July.....	54,150	52,630	60,654
August	52,912	52,171	61,606
September.....	53,295	52,440	63,078
October.....	55,490	53,340	63,471
November	55,635	55,719	62,792
December.....	54,428	54,905	63,365
Year.....	53,486	53,304	60,835

*E. & M. J., Jan. 11, 1913.



Copyright, Canada 1912, by Arthur A. Cole.

Silver Vein discovered^a in 1912. Assays 1,000 ounces Silver per ton, 200-foot level.

Spencer-Superior Mine, Cobalt, Ont.

Keegan

London continues to be the chief silver market of the world, and the basing point of prices, and much of the silver bullion shipped from Cobalt now goes direct to London.

The rise of one cent in the yearly average price of silver means an additional income to the shipping mines of Cobalt of about \$300,000.00. The 1912 average price with its 7.5 cents rise over 1911, raises the income of Cobalt by \$2,250,000.00. If we assume that the cost of production in 1912 was the same as for the preceding year, this large increase in income becomes directly available for increased dividends. This will doubtless be reflected in the dividend declarations for the early part of 1913.

At the beginning of 1912 there were 12 dividend paying companies, and this number was augmented by the addition of the Cobalt Townsite Company, which declared quarterly dividends during the year aggregating £80,000, or 40 per cent. on the capital stock of the company. Then in December the Cobalt Lake Company joined the list with the declaration of a 2½ per cent. dividend, or \$75,000, payable on the 2nd January, 1913.

The following companies have now repaid to their shareholders in dividends the amount of their capitalization, the Coniagas joining the number in 1912.

1. Buffalo.
2. Coniagas.
3. Crown Reserve.
4. Hudson Bay.
5. Kerr Lake.
6. McKinley-Darragh.
7. Nipissing.

Elk Lake.

The construction of a branch of the T. & N. O. Ry. into Elk Lake has had the effect of reviving considerable mining activity in this district. The most active property in this section of the country is the Beaver Auxiliary, formerly known as the Donaldson Claim, situated about two miles north of the town of Elk Lake. A development plant for this property was taken in as soon as the new line was opened.

All the silver finds in this area are in the diabase and when it is remembered that several of the surface showings in Elk Lake have been as good as those which occurred on the surfaces of the properties working in diabase in other districts that have become shippers, only the latter have had money expended on them for development, it would appear reasonable to conclude that some of the Elk Lake properties would become profitable shipping mines if capital is provided and sufficient development accomplished.

Gowganda.

The only regular shipper from Gowganda throughout the year has been the Miller Lake-O'Brien. A temporary setback was felt in the district with the closing down of the Millerett, but this property has since been acquired by the Miller Lake-O'Brien, which adjoins it, and these two properties will in future be worked together, the Millerett mill being used for concentration of the low grade ores.

The developments on the Mann claims have been of a most encouraging nature, and a bright future is looked for in this property. The Boyd-Gordon property which adjoins the Mann has been absorbed by the latter and the two properties are being developed together, the power being supplied by the Boyd-Gordon steam plant.

The building of the railway into Elk Lake is also having its effect on development in and around Gowganda, as the haul for ore and supplies is thus shortened about 23 miles.

South Lorrain.

The only shipping mine in this district during the year was the Wettlaufer. On this property 7 levels have been opened up with about $1\frac{1}{4}$ miles of underground workings, and attaining a depth of 555 ft. All the workings so far have been in post-Huronian diabase.

The high grade ore is hand-picked, while the lower grade material is put through a small mill. The milling plant consists of a sorting table, 2 trommels, 3 jigs, and 2 concentrating tables. A No. 5 Huntington mill is used to regrind the jig tailings.

The ore is teamed $3\frac{1}{2}$ miles to Silver Centre, on Lake Temiskaming, from whence it is shipped by boat to Temiskaming Station, at the foot of the lake, on the C. P. Railway, over which line it proceeds to the smelter.

In winter the ore is teamed to Haileybury and shipped out over the T. & N. O. Railway.

The following tables illustrate in statistical form the operations in the Cobalt district during 1912, along with comparisons with former years.

TABLE I.
SILVER PRODUCTION FOR THE COBALT DISTRICT.

Year	Tonnage	Value
1904.....	158.55	\$ 136,217.00
1905.....	2,336.01	1,485,570.00
1906.....	5,836.59	3,573,908.00
1907.....	14,851.34	6,155,391.00
1908.....	25,405.35	9,133,378.00
1909.....	30,057.58	12,456,301.00
1910.....	34,710.29	15,477,987.00
1911.....	25,710.22	15,953,895.00
1912.....	*22,393.39	17,455,080.00
	161,459.32	\$81,827,727.00

* This figure represents only the shipments of raw ore and concentrates for the year. To this must be added the silver bullion shipped by express, shown in Table VII., in order to obtain the total shipments for the year.

TABLE II.
Ore Shipments from Cobalt Silver District for the Calendar Year, 1912
(In tons of 2,000 pounds).

Mine.	Jan.	Feb.	March.	April.	May.	June.	July.	August.	Sept.	Oct.	Nov.	Dec.	Totals,
1 Bailey.....	62.00	.....	63.35	55.55	.....	38.76	63.82	.....	21.57	.....	20.00	41.57	402.97
2 Beaver.....	90.20	117.85	132.34	84.84	92.24	123.48	114.53	92.10	124.91	95.09	64.37	184.06	1,251.64
3 Buffalo.....	21.50	.....	43.85	102.40	.....	43.59	40	.....	43.59	65.50	.....	214.34	501.29
4 Casey Cobalt.....	32.00	32.00	32.00	64.00	32.00	31.70	32.00	73.29	73.29	65.50	42.00	73.20	501.29
5 Chambers-Ferland.....	54.00	25.81	32.70	.....	157.62	199.20	144.30	216.65	241.78	285.33	87.65	200.25	1,944.77
6 City of Cobalt.....	96.85	66.02	71.00	178.12	178.12	31.15	134.85	91.69	121.50	128.74	151.43	126.53	1,085.22
7 Cobalt Townsite.....	37.54	65.72	72.33	112.15	303.36	172.35	117.54	137.33	207.94	163.95	158.39	215.38	2,119.87
8 Cobalt Lake.....	170.01	124.86	112.15	20.00	21.60	21.60	21.60	21.55	21.55	21.55	21.55	23.33	86.48
9 Conigas.....	20.00	21.85	59.17	41.82	38.96	49.03	21.49	47.49	41.02	37.12	19.61	115.83	561.65
10 Colonial.....	68.27	300.00	.....	.....	18.56	20.74	.....	52.75	52.75	52.75	52.75	52.75	66.80
11 Crown Reserve.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	458.86
12 Drummond.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	17.35
13 Harrgrave.....	62.95	61.58	63.34	62.03	62.75	31.60	96.86	62.80	35.61	30.85	93.26	30.92	694.56
14 Hudson Bay.....	30.29	83.00	84.18	85.38	50.77	30.37	60.55	105.78	45.93	90.95	92.00	28.90	788.00
15 Kerr Lake.....	217.60	276.46	353.78	255.79	424.03	274.96	152.63	342.37	315.23	251.17	260.62	386.76	3,511.40
16 La Rose.....	.....	.....	.....	.....	.....	15.00	.....	15.00	15.00	17.00	32.46	32.46	65.20
*17 Lost and Found.....	169.28	225.79	212.41	220.38	202.81	348.78	168.52	151.79	206.77	135.44	245.73	2,673.40	2,673.40
18 McKinley-Darragh.....	118.11	299.75	103.63	226.39	196.80	227.91	170.76	228.61	179.24	31.52	86.59	1,869.27	1,869.27
19 Nipissing.....	61.15	67.85	52.02	.....	63.96	31.25	69.39	107.70	107.70	107.70	64.79	86.00	711.43
20 O'Brien.....	.....	.....	.....	.....	.....	.....	.....	20.69	31.25	34.46	30.95	30.95	126.35
*21 Penn-Canadian.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	191.63	241.34	432.97	432.97
*22 Peterson Lake.....	22.00	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	22.22
23 Provincial.....	38.86	32.59	43.73	38.30	.....	26.55	30.61	32.60	.....	.....	.....	.....	243.24
24 Right of Way.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	31.25
25 Silver Queen.....	41.88	98.86	85.67	65.87	197.64	95.52	61.83	62.85	50.58	96.51	66.22	43.98	907.31
26 Temiskaming.....	17.62	54.80	48.14	26.50	60.37	77.26	.....	70.35	27.65	66.25	58.00	72.16	579.10
27 Trehaway.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Totals.....	1,235.07	2,063.63	1,678.13	1,782.79	1,928.72	1,707.37	1,669.55	1,980.12	1,871.48	1,775.61	1,608.48	2,380.84	21,631.79

* December shipment made by the General Mines, they having acquired this property. The General Mines is operating the Red Rock, Ruby,

Cobalt, Contact and the Azumico (formerly Temiskaming Cobalt),

† Formerly the Cobalt Central,
‡ Seneca-Superior Lease.

TABLE III.
Ore shipments from the Cobalt District for the years 1904-1912.
(In tons of 2,000 lbs.)

The shipment in 1905 was made by the White Silver Mining Company, the former owner of the Hargrave property.

1907 included with the Rose

* Shipments up to end of 1911 made by the Cobalt Central Mining Company, former owner of the Penn-Canadian.

TABLE IV.

Table showing shipments from Elk Lake and Gowganda during years 1909, 1910, 1911 and 1912.
(In tons of 2,000 lbs.)

Mine.	1909	1910	1911	1912	Totals.
Elk Lake.	tons.	tons.	tons.	tons.	tons.
Hitchcock .....	.....	.....	4.00	.....	4.00
Lucky Godfrey	17.00	.....	.....	.....	17.00
Moose Horn	3.00	.....	.....	.....	3.00
Gowganda.					
Bartlett	2.00	.....	6.75	.....	8.75
Bonsall .....	.....	6.78	.....	.....	6.78
Boyd-Gordon	30.00	1.25	.....	.....	31.25
Burke Remey	2.00	.....	.....	.....	2.00
Calcite Lake .....	.....	.....	8.50	.....	8.50
Canadian Gowganda .....	.....	.....	8.00	.....	8.00
Everett	8.35	.....	.....	.....	8.35
Mann .....	.....	.....	16.00	.....	16.00
Millerett	346.30	128.00	188.00	.....	662.30
Miller Lake—O'Brien	31.00	116.50	112.60	.....	260.10
Powerful .....	.....	1.00	.....	.....	1.00
Reeves-Dobie	61.00	5.00	.....	.....	66.00
Welsh	1.25	.....	.....	.....	1.25
Totals	2.60	506.68	262.50	333.10	1,104.28

TABLE V.

Statement showing Ore Shipments from South Lorrain.
(In tons of 2,000 lbs.)

Mine.	1908	1909	1910	1911	1912	Totals
Wettlaufer .....	.....	111.50	226.64	496.00	478.00	1,313.14
Keeley	43.25	1.09	.....	21.26	.....	65.06
Bellellen .....	.....	.....	.....	13.25	.....	13.25
	43.25	112.59	226.64	530.51	478.00	1,390.99

TABLE VI.

Statement showing Shipments from Cobalt District, including Gowganda, Elk Lake and South Lorrain. (In tons of 2,000 lbs.)

Years.	Cobalt.	Gowganda.	Elk Lake.	S. Lorrain.	Totals.
1904	158.55	.....	.....	.....	158.55
1905	2,336.01	.....	.....	.....	2,336.01
1906	5,836.59	.....	.....	.....	5,836.59
1907	14,851.34	.....	.....	.....	14,851.34
1908	25,362.10	.....	.....	43.25	25,405.35
1909	29,942.99	2.00	.....	112.59	30,057.58
1910	33,976.97	486.68	20.00	226.64	34,710.29
1911	24,921.71	267.00	4.00	530.51	25,723.22
1912	21,631.79	324.60	.....	478.00	22,434.39
	159,018.05	1,080.28	24.00	1,390.99	161,513.32

TABLE VII.
Statement Showing Bullion Shipments from the Cobalt District
(During Calendar Year 1912)

Mine	Weight, Ozs.	Value
1. Bailey.....	5,404	\$ 3,287.52
2. Beaver.....	4,369	2,657.88
3. Buffalo.....	205,302	124,895.47
4. Casey Cobalt.....	1,052	639.97
5. Chambers Ferland.....	2,606	1,585.36
6. City of Cobalt.....	4,808	2,925.15
7. Cobalt Lake.....	5,974	3,634.28
8. Cobalt Townsite.....	10,726	6,525.16
9. Colonial.....	1,837	1,117.00
10. Crown Reserve.....	346,234	210,631.45
11. Drummond.....	7,246	4,408.71
12. Hargrave.....	5,477	3,331.93
13. Kerr Lake.....	171,645	104,420.24
14. McKinley-Darragh S.....	79,526	49,703.00
15. Nipissing.....	4,255,013	2,607,734.00
16. Nipissing Reduction.....	615	374.14
17. O'Brien.....	229,360	141,765.00
18. Penn Canadian.....	445.1	278.00
19. Right of Way.....	677	411.85
20. Temiskaming.....	72,363	44,022.03
21. Trethewey.....	31,330	19,059.60
22. Wetlaufer.....	7,723	4,698.29
 Totals	 5,449,732.1	 \$3,338,106.03
Total for 1910.....	945,703.11	501,815.33
Total for 1911.....	3,772,920.11	2,012,428.95
Total for 1912.....	5,449,732.11	3,338,106.03
 Grand Total.....	 10,168,355.11	 \$5,852,350.31

The above bullion figures may be taken as practically correct, though in some cases they may be slightly incorrect where production figures are assumed to be shipments.

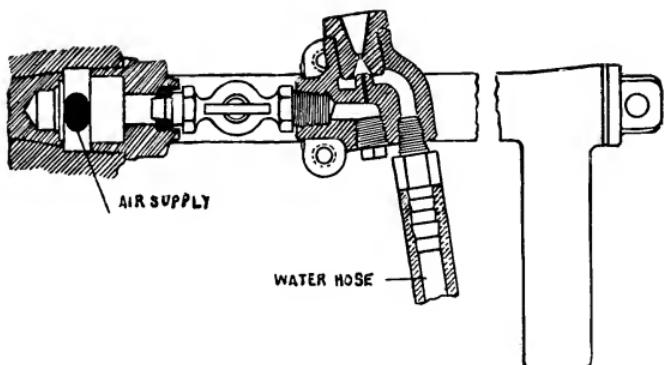
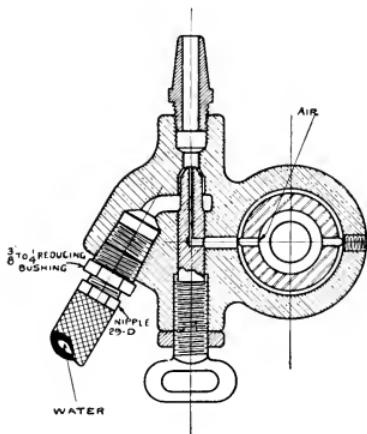
UNDERGROUND CONDITIONS.

Miners' phthisis has recently been classed by a South African Commission as an industrial disease, and subject to compensation as such. No class of mine labor is exempt from it, but machine drillers are most subject to this disease.

Recent attempts to overcome this dust difficulty are of general interest to all branches of the mining industry. During 1912 a clause was inserted in the Mining Act of Ontario, under which the mine inspector has power to insist on means being adopted to keep down the dust. The clause is section 164, subsection 60:

"Every dusty place where work is being carried on in a mine shall be adequately supplied at all times with clean water under pressure or other approved appliances for laying the dust caused by drilling or blasting operations."

Both piston and hammer drills are used in the mines of Northern Ontario, but the hammer drills are the greater offenders as dust makers and spreaders. A



Two Types of Sprayers or Dust Allayers.

number of different makes of hammer drills are now operating in the mines at Cobalt and Porcupine, the principal ones being the Rand, Sullivan, and Waugh. For each of these machines a sprayer or dust allayer has been introduced, and already working conditions have been improved. Two types of these dust allayers are figured on p. 36. Although these innovations are introduced primarily for the benefit of the employee, and the employer only benefits indirectly by the increased efficiency of the labor employed, the principal difficulty in their adoption lies with the employee. This is another case of the common experience where companies find it extremely difficult to make their miners observe even the more simple necessary precautions. In all kinds of work men willingly court known and certain hazards rather than take a little trouble to guard against them. The objection to the sprayer seems to be that the drillers are put to the extra trouble of providing buckets of water at intervals.

The sprayers are all designed on the injector principle. Each drill company has a sprayer attachable to its own make of machine. They are light, weighing only 3 to $3\frac{1}{2}$ lbs. A small amount of live air is drawn off from the air supply in the drill, and this, passing through the sprayer, draws up water through a short length of hose from a pail or other convenient source, and projects it in the form of a finely disseminated spray or mist against the collar of the hole. It is only the very finest dust which jeopardises the health of the miners, so only the minutest particles of dust need wetting down, the larger cuttings falling to the floor of their own weight. Water can be sucked up six or eight feet from a pail or bucket, no tank or pressure line being necessary. The amount of water used will run from one to two buckets per shift, and the air consumption of the device is small enough to be practically negligible.

Not only is the freedom from dust of great benefit to the miners themselves, but it is found that the grit does not penetrate the machine and wear it out as rapidly as formerly. It is also claimed that the dissemination of this spray into the air of the mine has a beneficial effect in assisting to clear the air of powder gas.

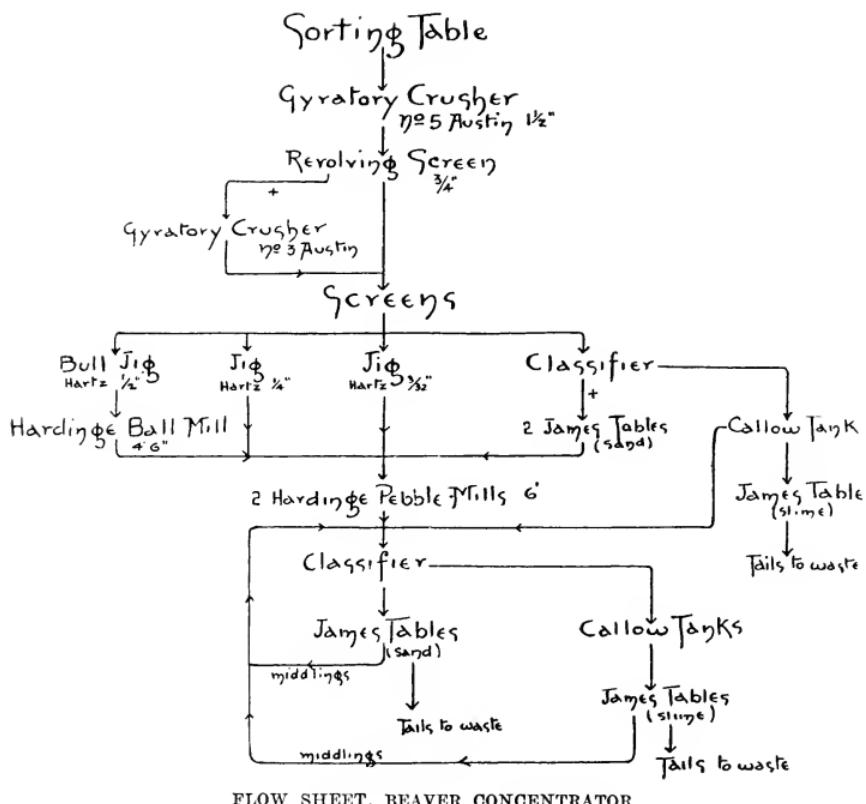
In very cold weather in cold parts of the mine it is difficult to use this dust-laying attachment without having it freeze up.

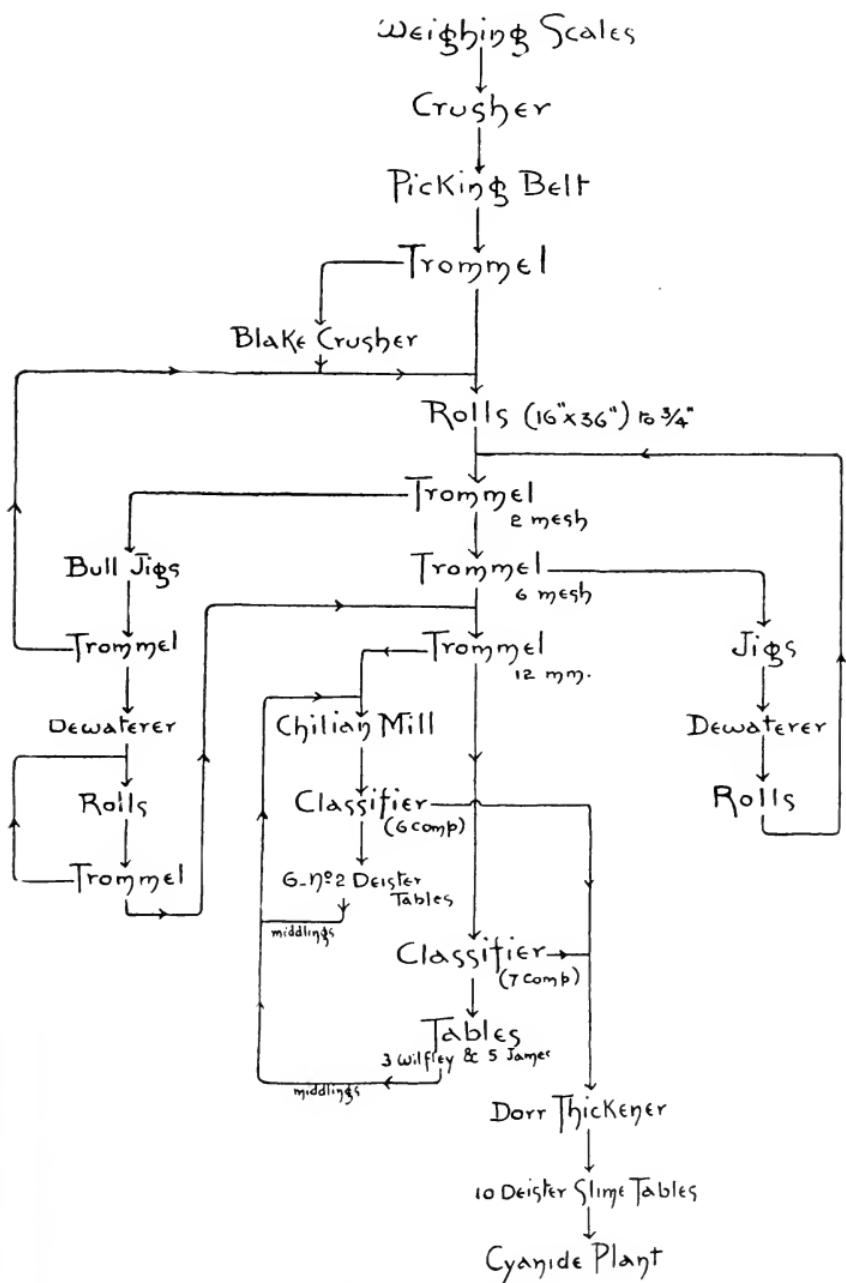
CONCENTRATION.

The reduction of low grade ores at Cobalt plays a more important part each year in the history of the district. Thus the year 1912 reached a new record, the mills having treated a total of 455,516 tons. With the enlargements either planned or already accomplished at the Northern Customs, Beaver, McKinley-Darragh, Cobalt Lake, and Casey Mills, 1913 bids fair to show further substantial increases.

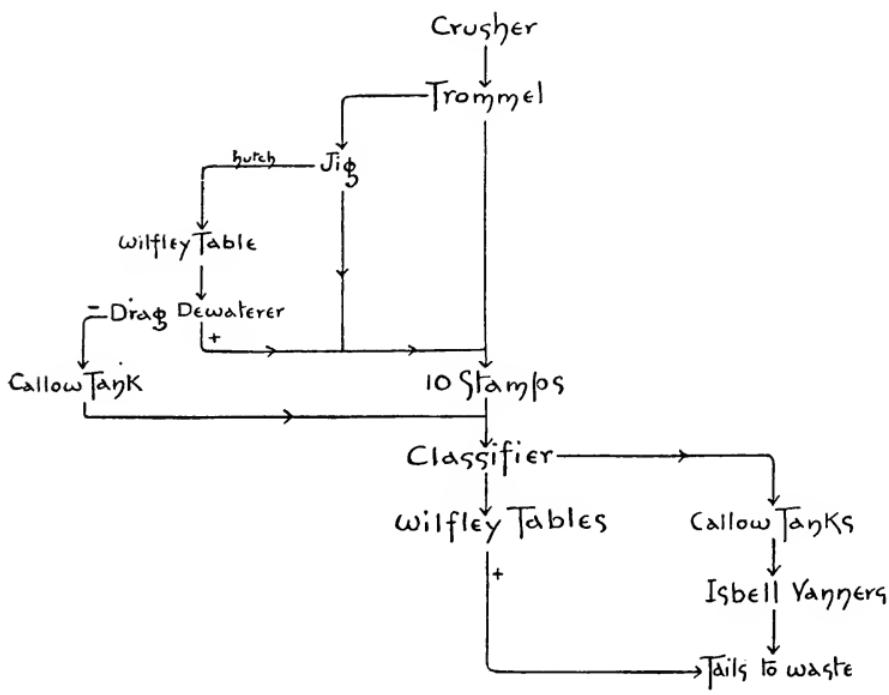
During 1912 the Penn-Canadian mill, formerly known as the Cobalt Central, was re-opened, and the new mills of the Beaver, Nipissing and Casey were put into commission.

The high grade mill of the Nipissing operated steadily during the year, and the Buffalo completed a similar mill and started operations towards the end of the year.

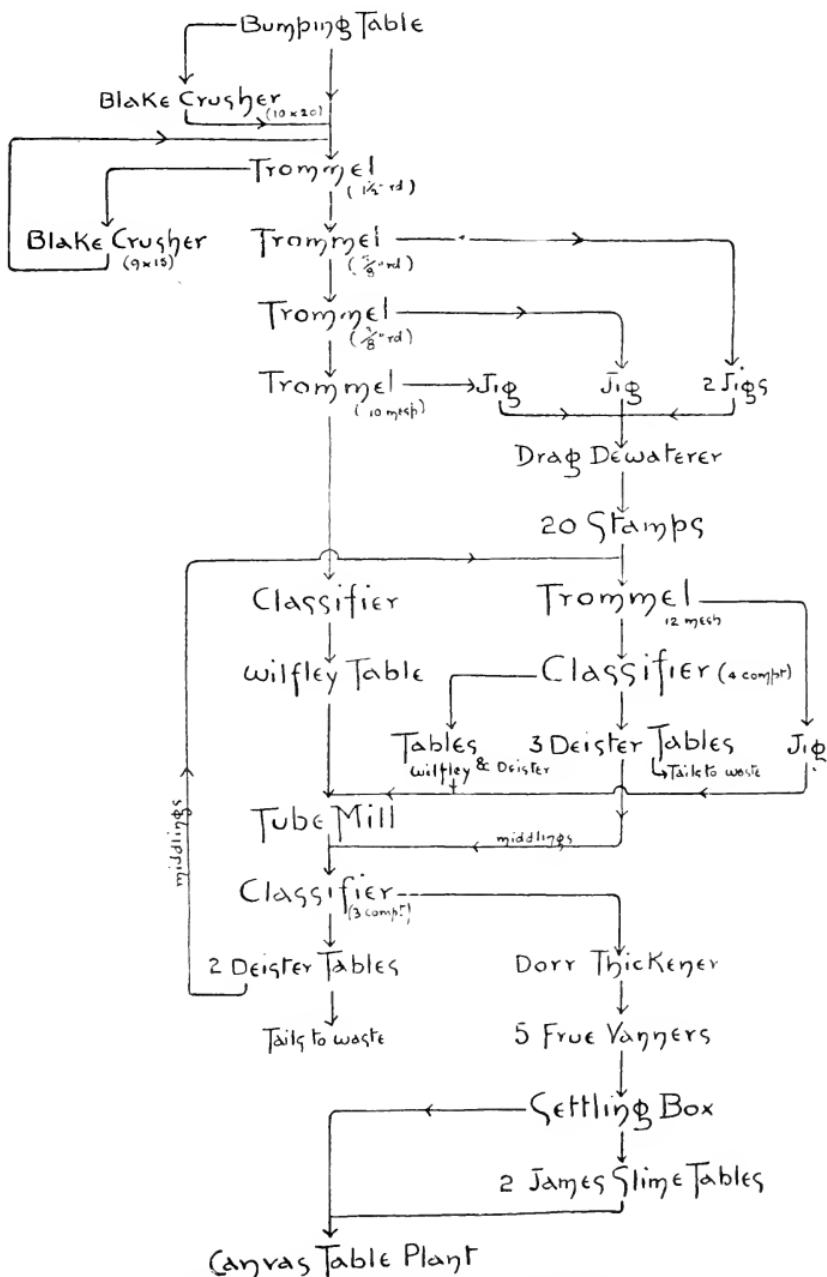


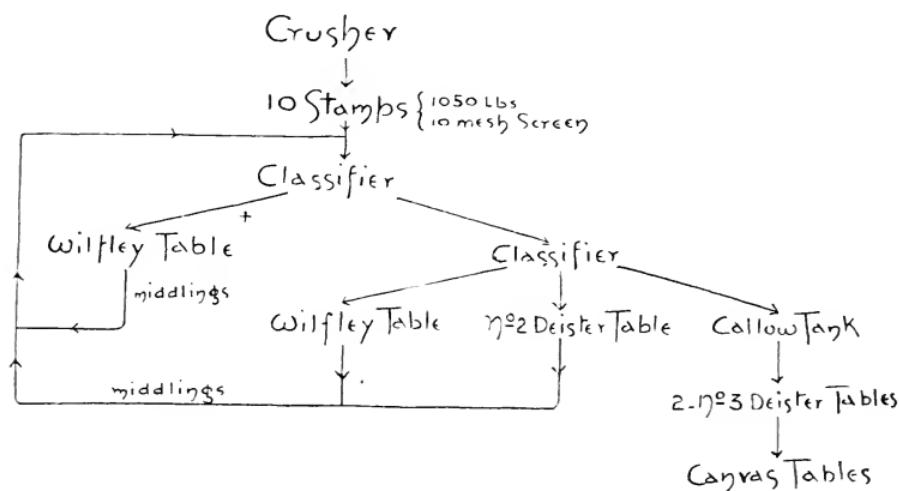


FLOW SHEET, BUFFALO MILL

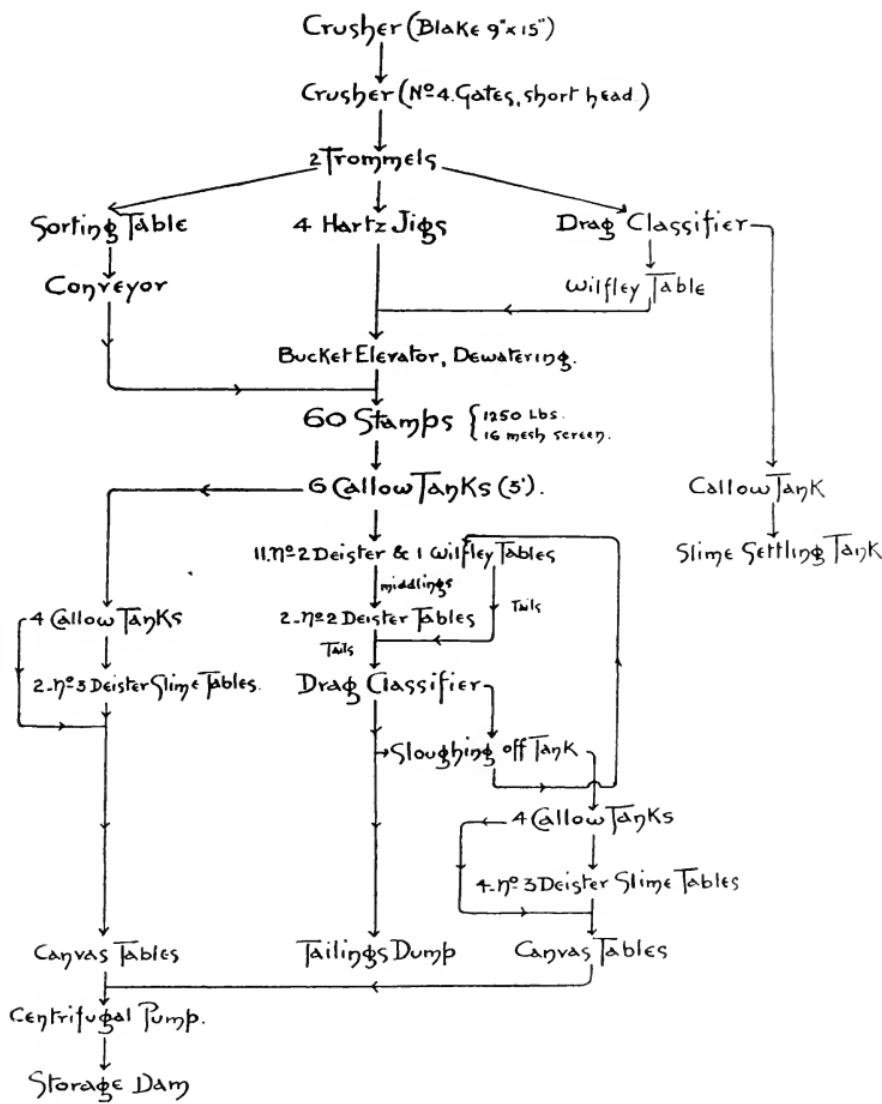


FLOW SHEET, CASEY COBALT CONCENTRATOR.

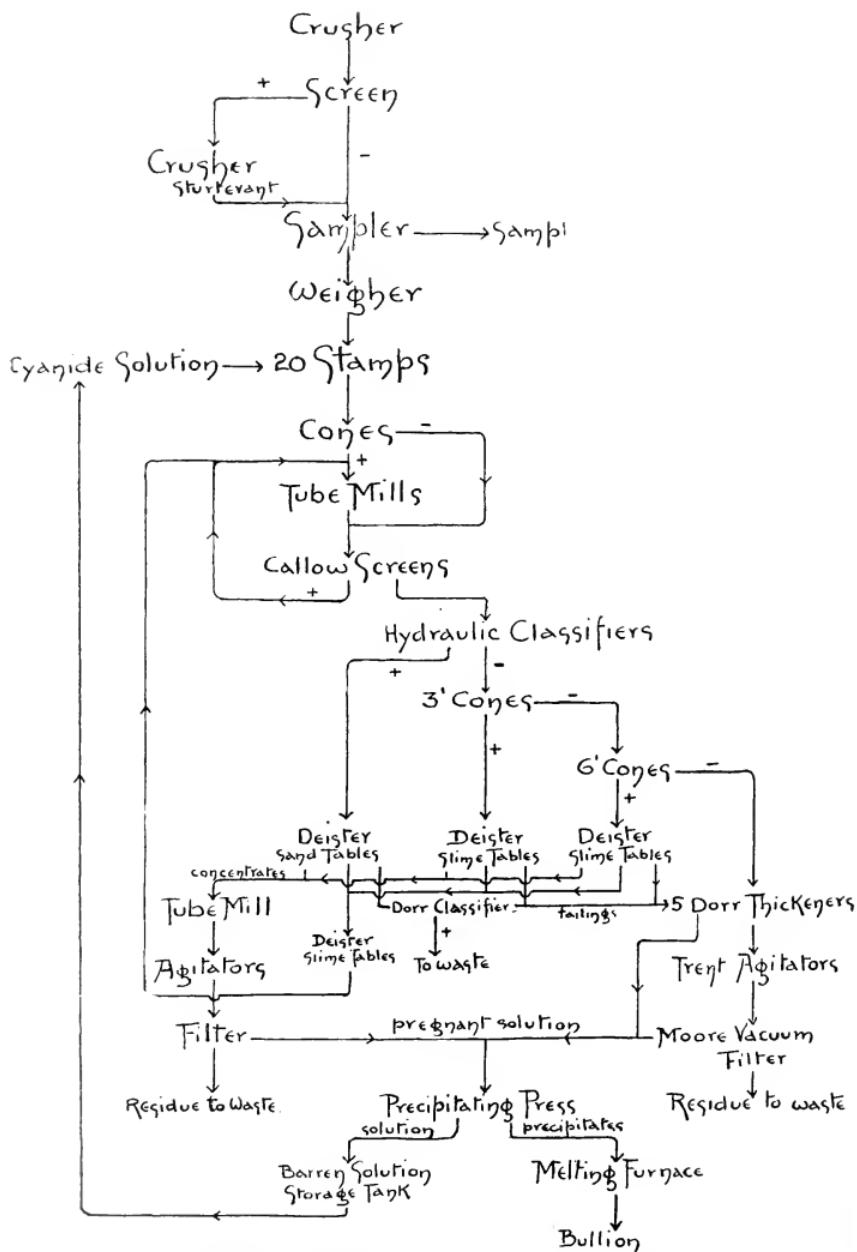




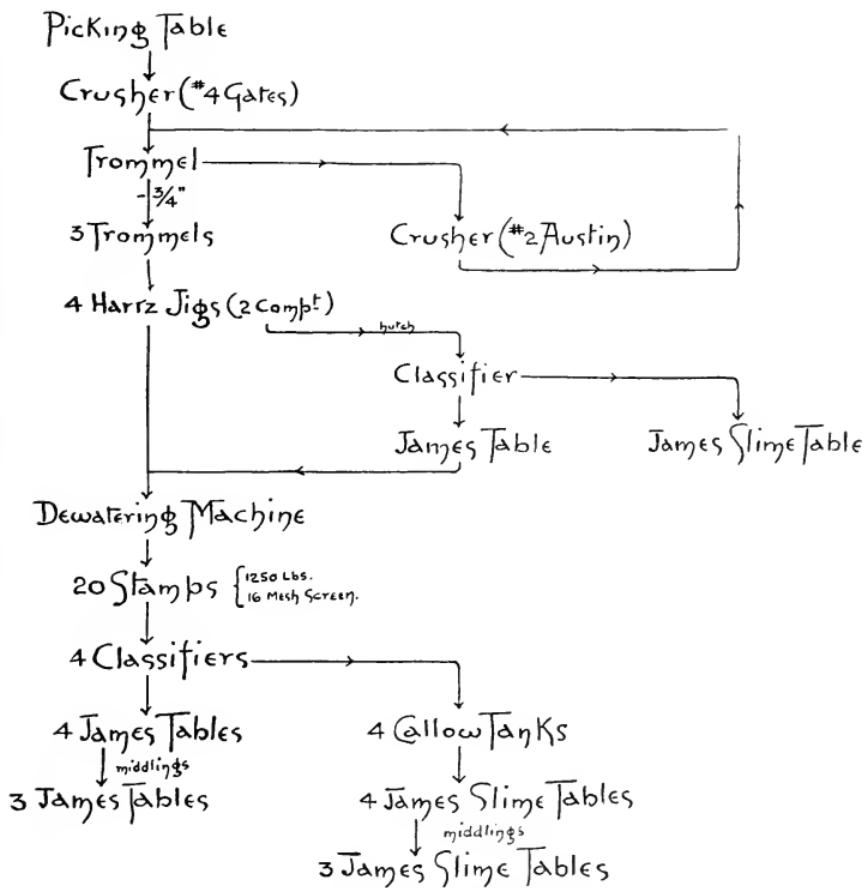
FLOW SHEET, COLONIAL CONCENTRATOR.



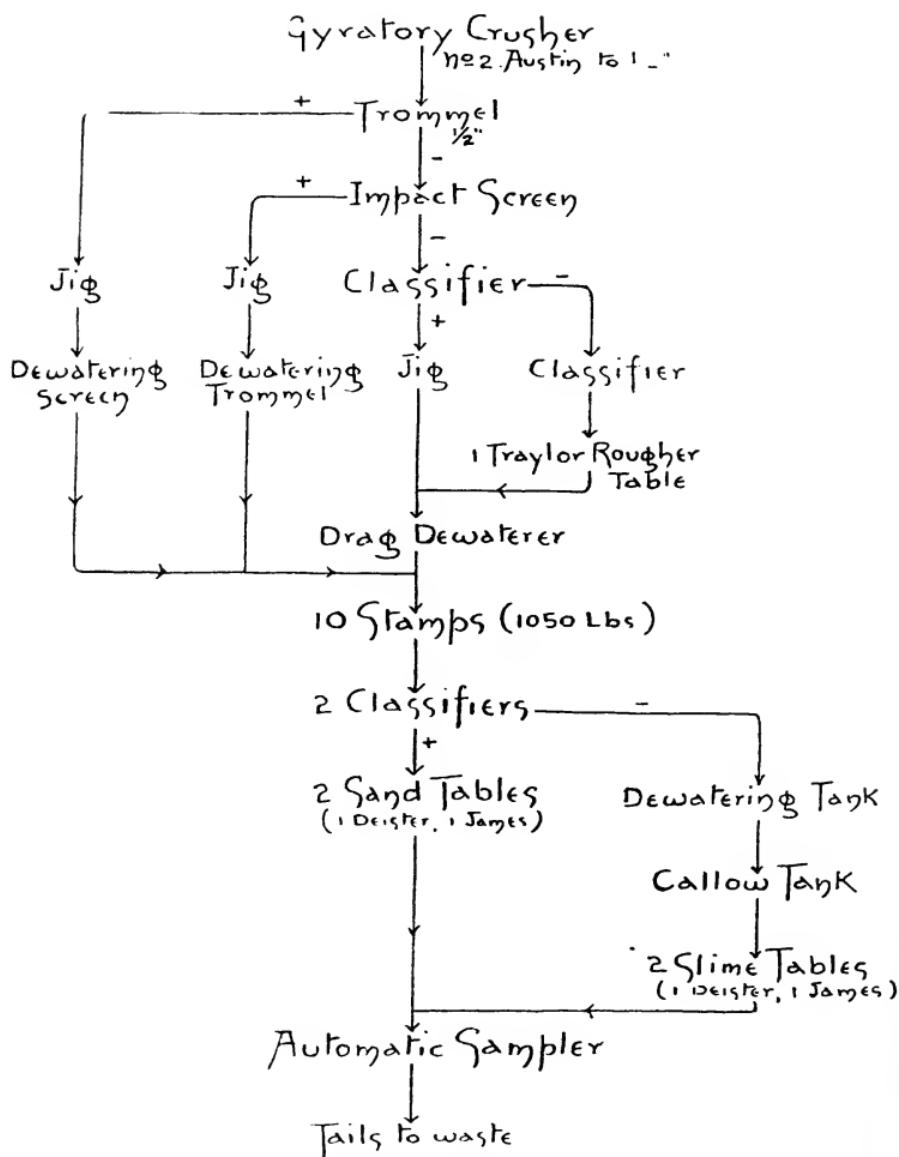
FLOW SHEET, CONIAGAS CONCENTRATOR.



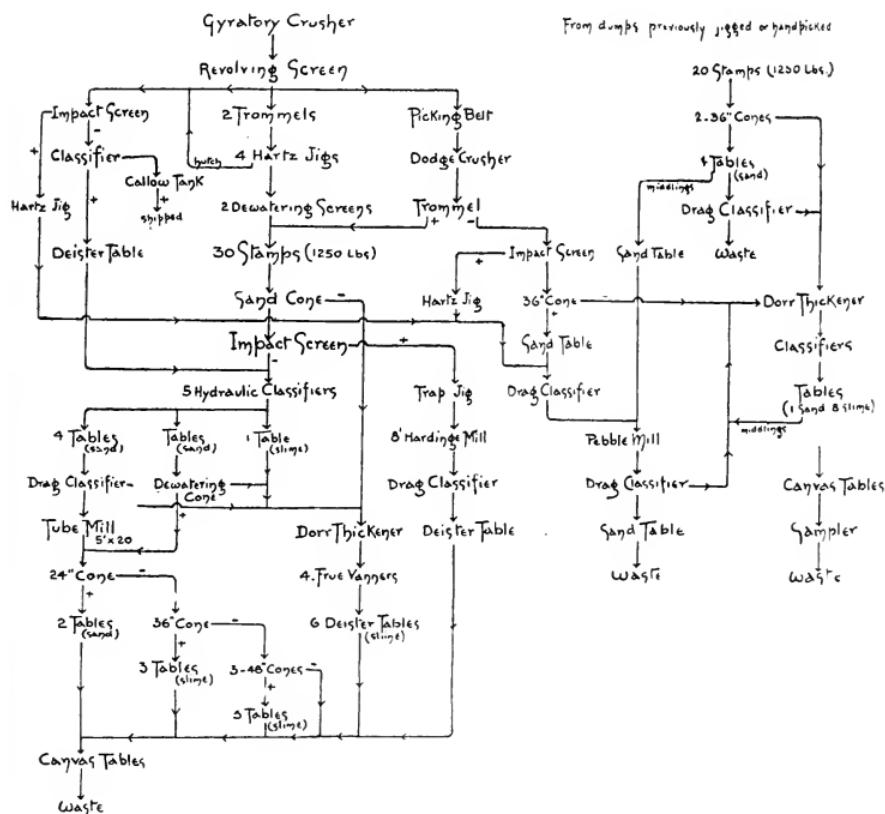
FLOW SHEET, DOMINION REDUCTION COMPANY MILL.

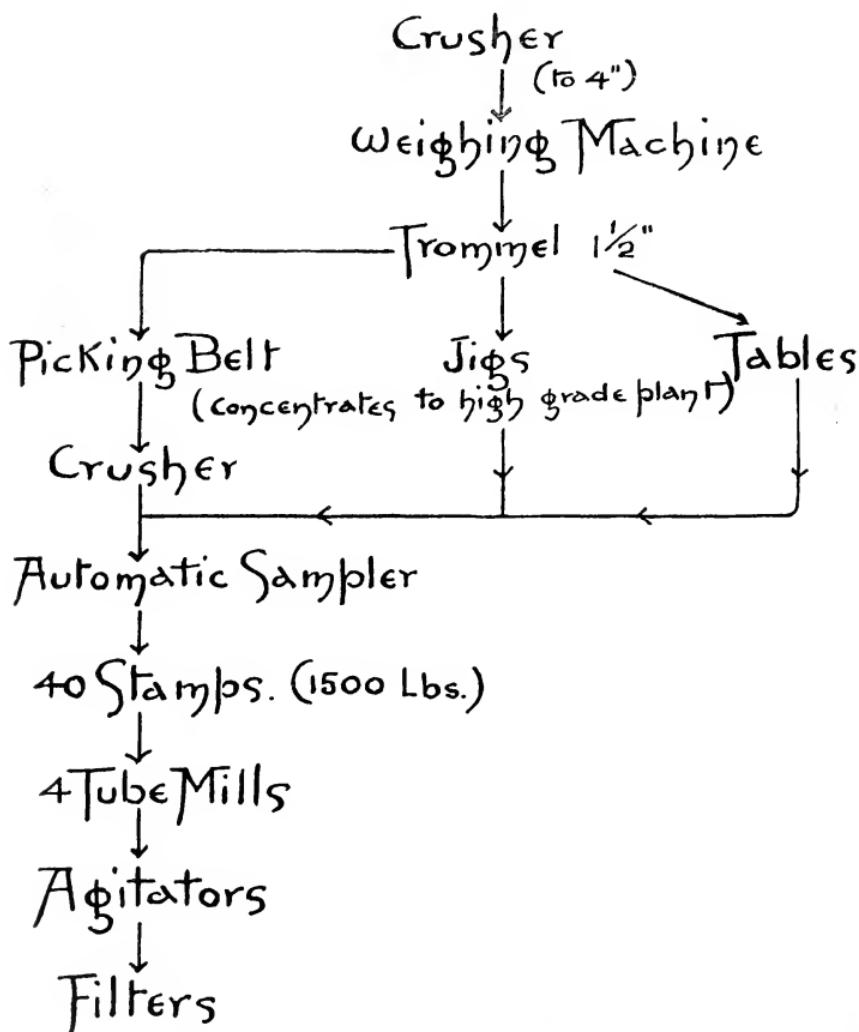


FLOW SHEET, HUDSON BAY CONCENTRATOR.

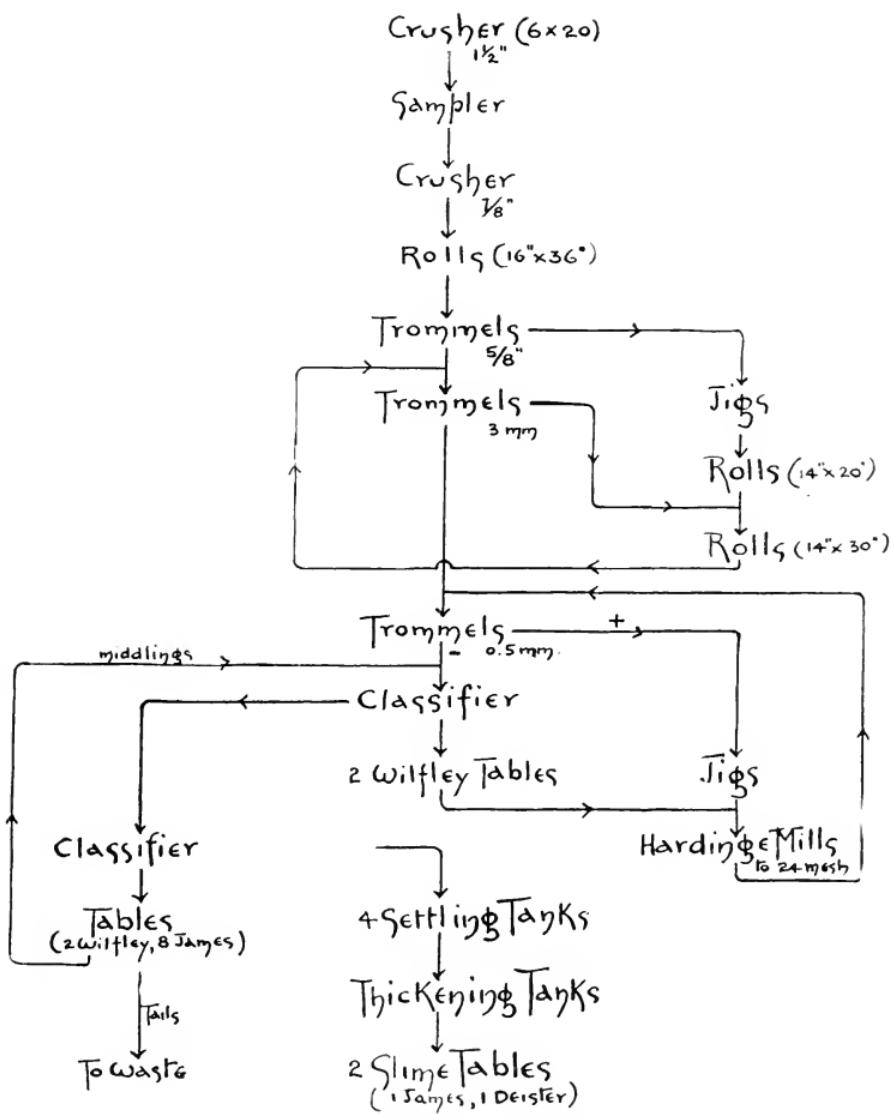


FLOW SHEET, KING EDWARD CONCENTRATOR.

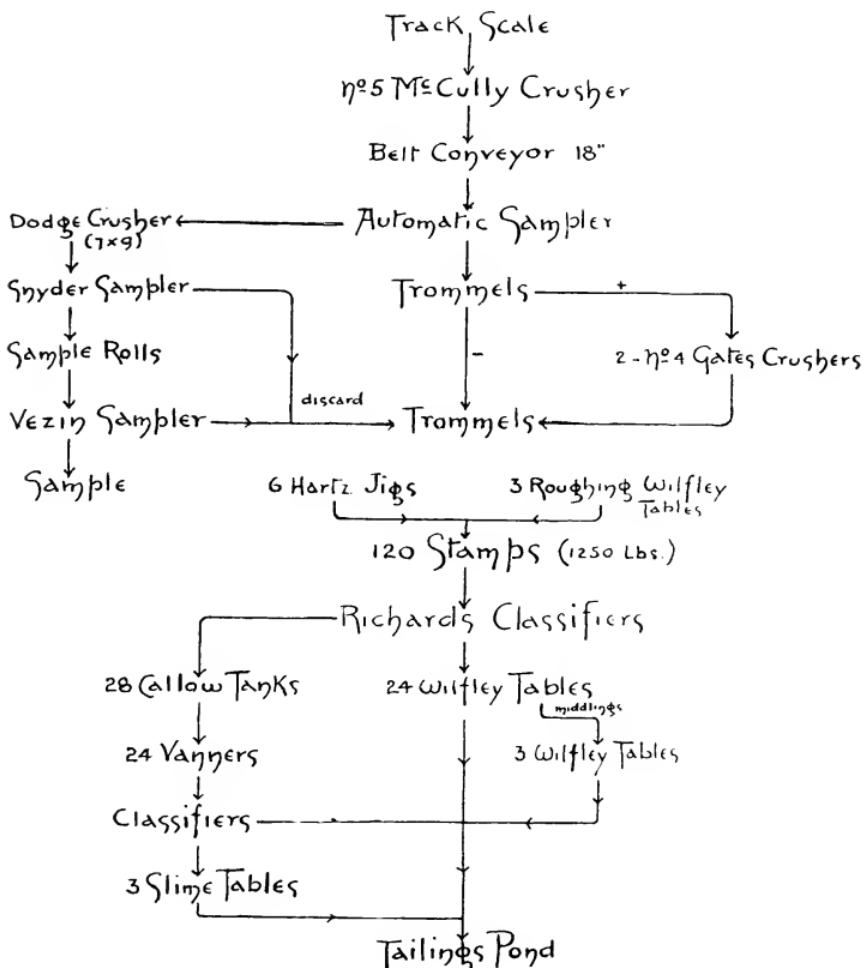




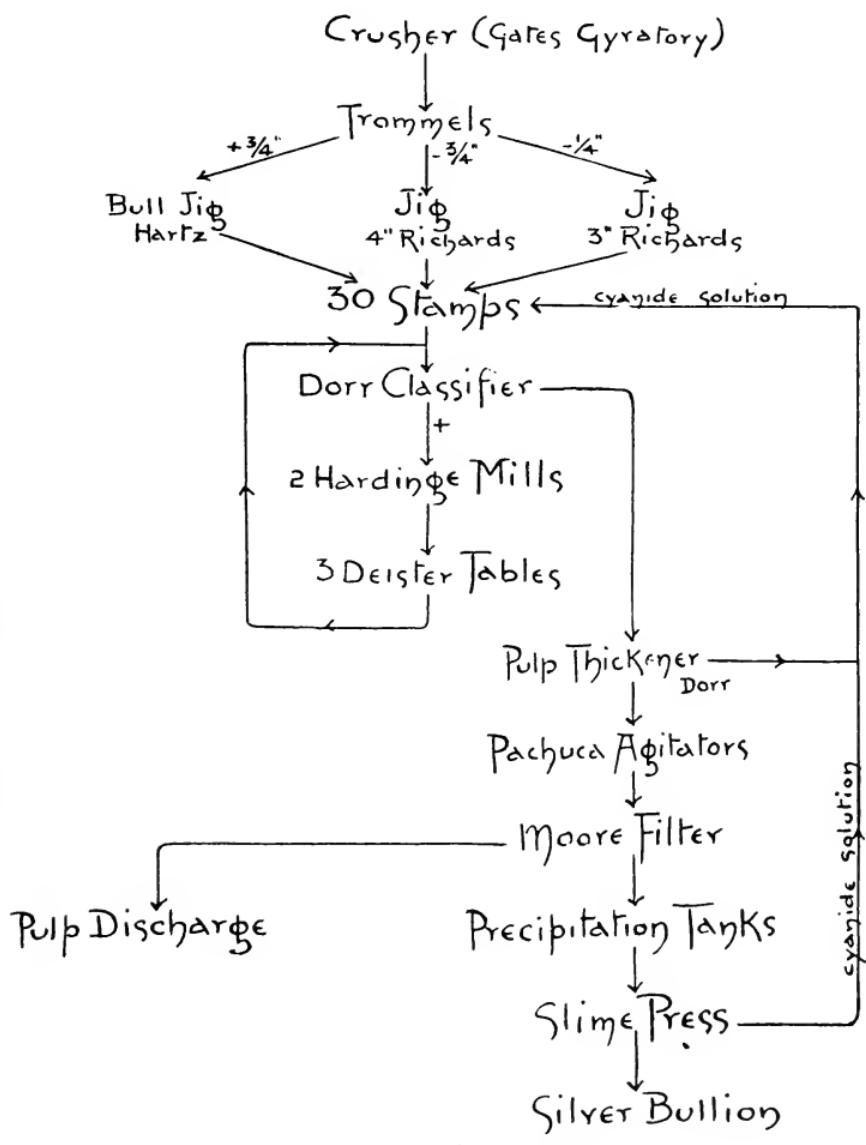
FLOW SHEET, NIPISSING MILL.

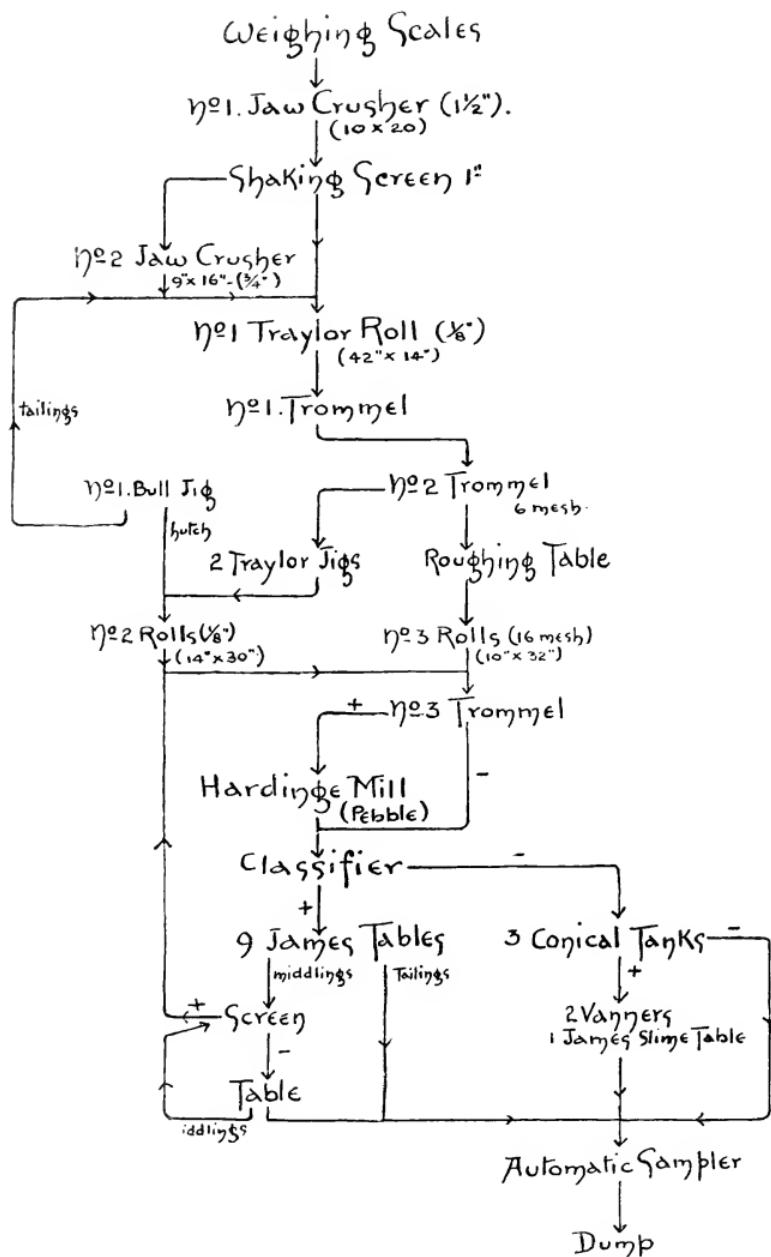


FLOW SHEET, NIPISSING REDUCTION MILL.

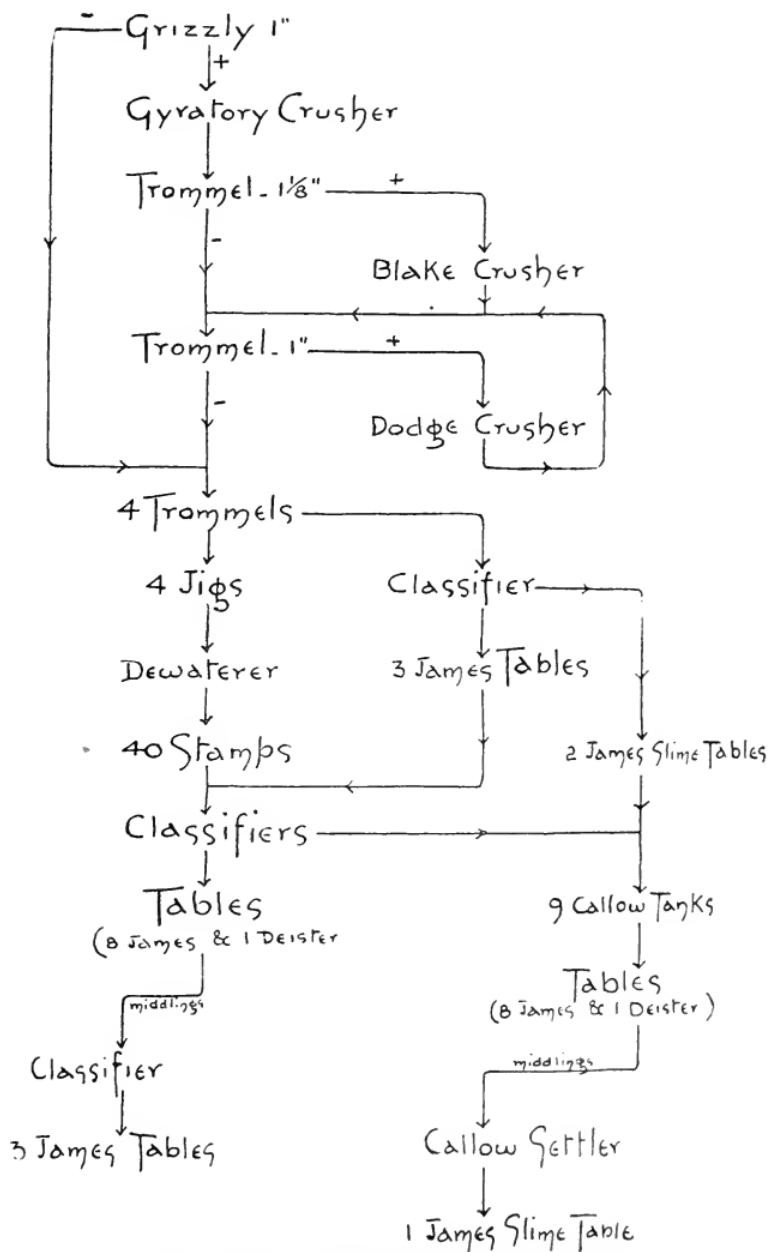


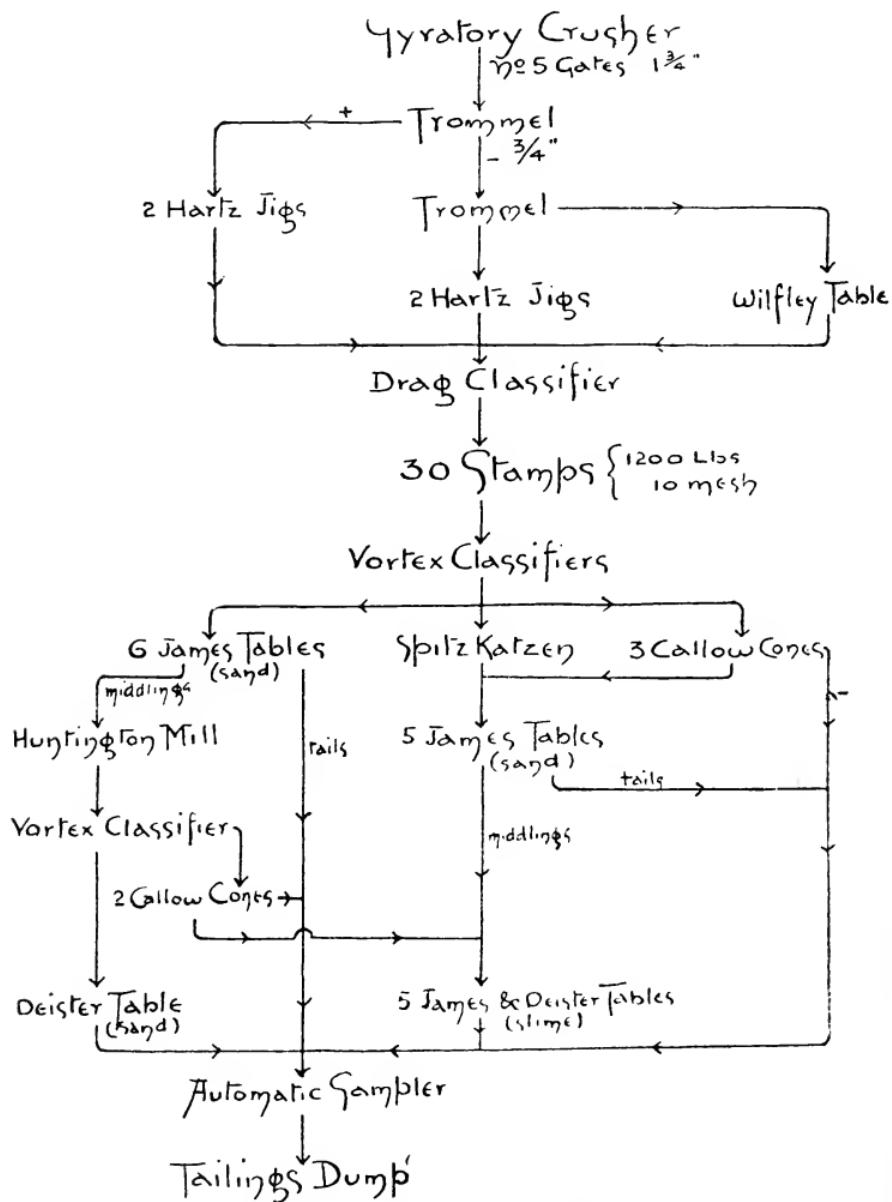
FLOW SHEET, NORTHERN CUSTOMS CONCENTRATOR.





FLOW SHEET, PENN-CANADIAN CONCENTRATOR.





CONCENTRATION IN COBALT DURING 1912.

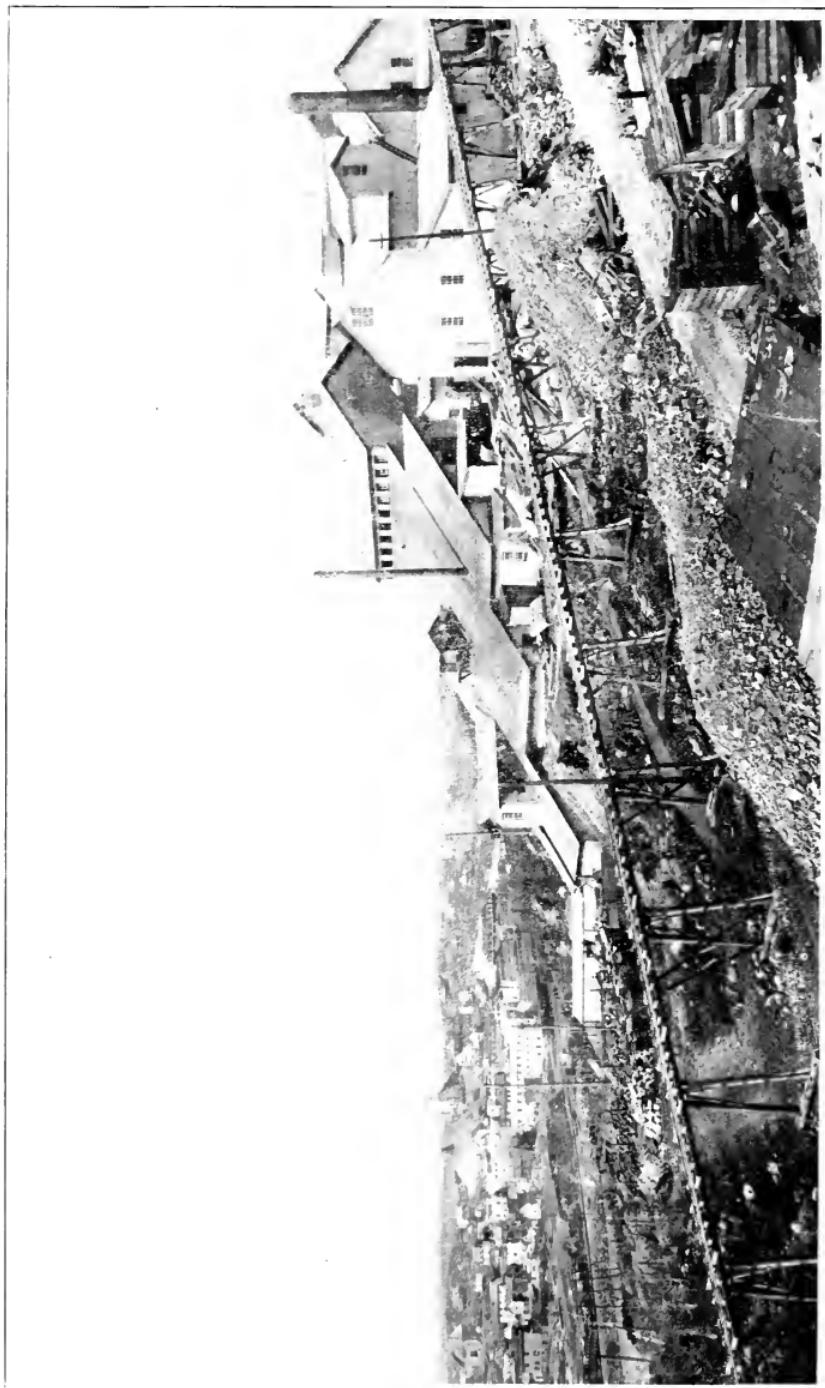
Mills and Mines.	Tons Milled.	Concentrates.			Concentration Ratio.
		Jigs.	Tables.	Totals.	
1. Beaver.....	14,602.0	113.4	129.3	242.7	60-1
2. Buffalo	51,900.0			1,242.2	42-1
3. Casey Cobalt.....	1,585.0		43.2	43.2	36-1
4. Cobalt Lake	23,410.4	182.2	477.3	659.5	36-1
5. Colonial.....	7,692.0			86.0	89-1
6. Coniagas.....	52,797.5	253.0	919.0	1,172.0	45-1
7. Hudson Bay	21,509.0	177.0	453.0	630.0	34-1
8. King Edward.....	9,895.5	65.7	200.0	265.7	37-1
City of Cobalt.....					
9. McKinley-Darragh	51,897.0	516.9	1,406.4	1,923.3	22-1
10. Nipissing Reduction.					
Cobalt Lake.....	1,803.4	62.7	16.8	79.5	23-1
Green Meehan.....	795.5	7.3	6.9	14.2	56-1
Nipissing	14,251.0	87.0	97.5	184.5	78-1
Silver Queen.....	219.8	2.8	1.6	4.4	50-1
11. Northern Customs.					
Drummond.....	3,427.0		111.1	111.1	31-1
La Rose	33,984.0		1,210.5	1,210.5	28-1
Townssite.....	27,898.0		1,074.0	1,074.0	26-1
12. Penn Canadian.					
Penn Canadian	5,400.0			95.3	57-1
Hargraves	546.0			4.2	130-1
13. Temiskaming	40,056.0	280.7	609.3	890.0	45-1
14. Treltheway	26,803.9	159.6	435.1	594.7	45-1
Total	390,473.0	tons.		10,527.0	37-1
Cyanide Mills.			Tons.	Bullion Produced. Ozs.	
15. Dominion Reduction.....					
Crown Reserve.....			15,704.0		346,234
Kerr Lake.....			5,983.0		130,075
16. Nipissing.....			3,447.0		57,875
17. O'Brien			39,909.5		229,360
			65,043.5		763,544
Total tons milled by water concentrating mills			390,473.0		
" " " cyanide mills.....			65,043.5		
Total tons milled, 1912.....				455,516.5	

Dominion Reduction Mill.

This mill, which was formerly known as the Nova Scotia mill, recommenced operations, and is now working steadily on ores from the Crown Reserve and Kerr Lake. The amalgamating pans formerly used are to be replaced by a tube-mill, the discharge from which will go to agitators for the fine ground concentrate product for separate cyanidation, and no residues will be shipped to the smelter.

Buffalo Mill.

The concentrates from this mill are now treated in the Company's High-Grade mill. Besides this the cyanide plant recovered 100,221 ounces silver from the slimes treated.



High-Grade Mill, Nipissing Mining Company, Cobalt, Ont.

O'Brien Mill.

This mill produced and shipped 313 tons of concentrates, which contained 229,271 ounces silver, and also recovered in their cyanide plant 229,360 fine ounces silver, valued at \$141,765.00.

Nipissing Low Grade Mill.

This new mill did not start operations till late in the year, which will explain the small quantity treated. The 116 tons of concentrates made were sent to the High-Grade mill for treatment, and the amount of silver recovered by cyaniding the remainder was 57,875 ounces, valued at \$35,882.00.

Although most of the following flow sheets have been published before, there have been quite a number of changes more or less important which made them seem worthy of repetition, bringing them up to date.

The only mill idle in the camp at the end of the year was the Silver Cliff, and this was re-opened early in 1913.

HIGH GRADE MILL—NIPISSING MINING COMPANY.

Owing to the great complexity of the high grade silver ores of the Cobalt District, and particularly on account of their high arsenic contents, they have always been considered undesirable ores by the ordinary custom smelter. A heavy smelting charge was consequently exacted by the smelters for their treatment.

Experiments were carried on by the Nipissing Mining Company for a considerable length of time in an endeavor, if possible, to find some method of treating the ore in the district so that the final product to be shipped out should be refined silver bullion. A simple and effective process was finally worked out by Charles Butters, assisted by G. H. Clevenger. The plant, which was designed and constructed by James Johnston, commenced operations February 1st, 1911, and has run successfully ever since.

After the ore has been crushed in a 9 x 15 inch Blake crusher, it is ground to pass 20 mesh in a No. 3 6 ft. ball mill, and then sampled.

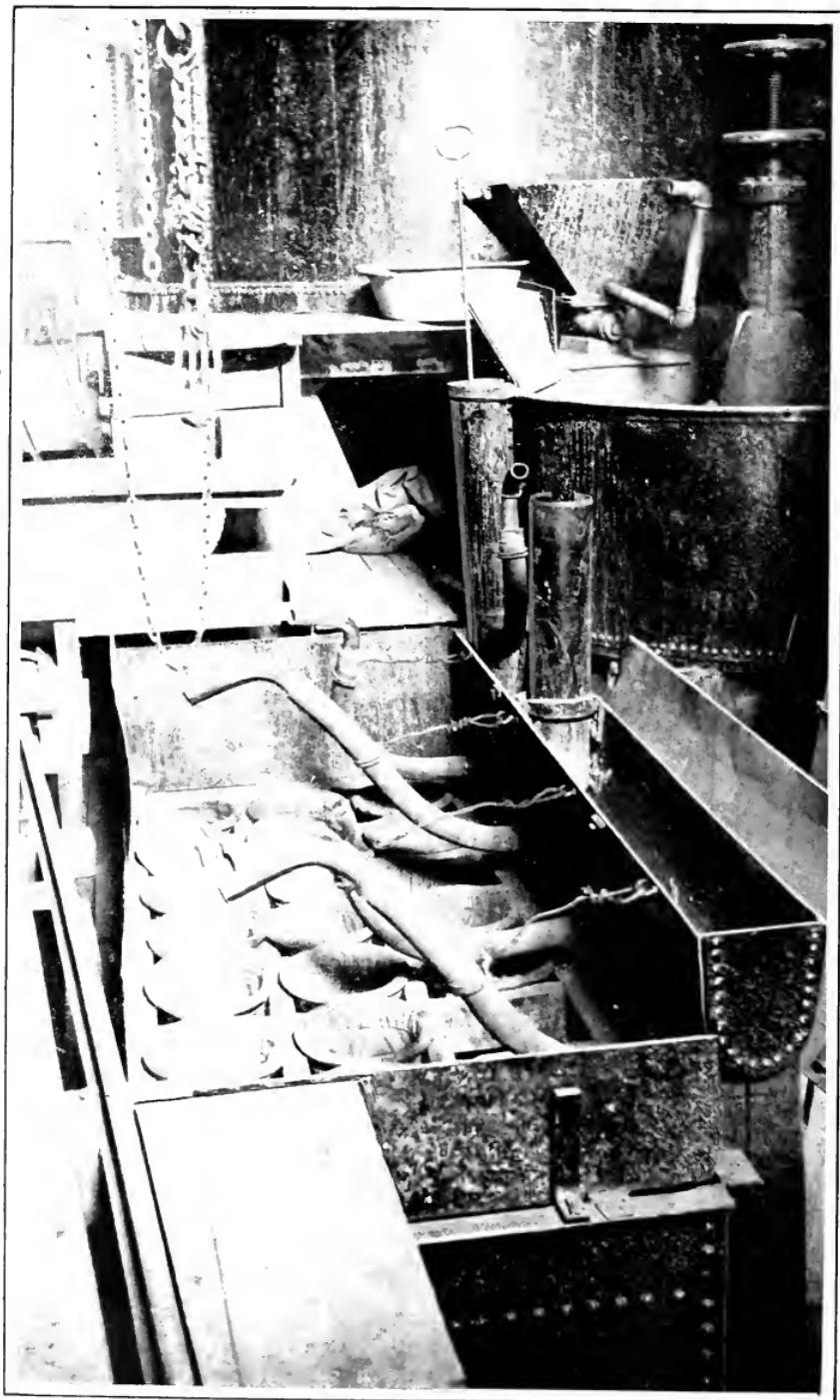
Treatment.

"The main operation consists of amalgamating the silver in a 5 per cent. cyanide solution while the 20-mesh material is being ground in a tube mill. The mill used is a Krupp mill 3 ft. 11 in. in diameter and 19 ft. 8 in. long, fitted with silex liners and run at 37 r.p.m. The weight of ore per charge depends somewhat on the silver content, but with 2,500 oz. ore the ordinary tube mill charge is 6,500 lb. of ore, 8,500 lb. mercury, and 3,800 lb. of cyanide solution, and 6 tons pebbles.

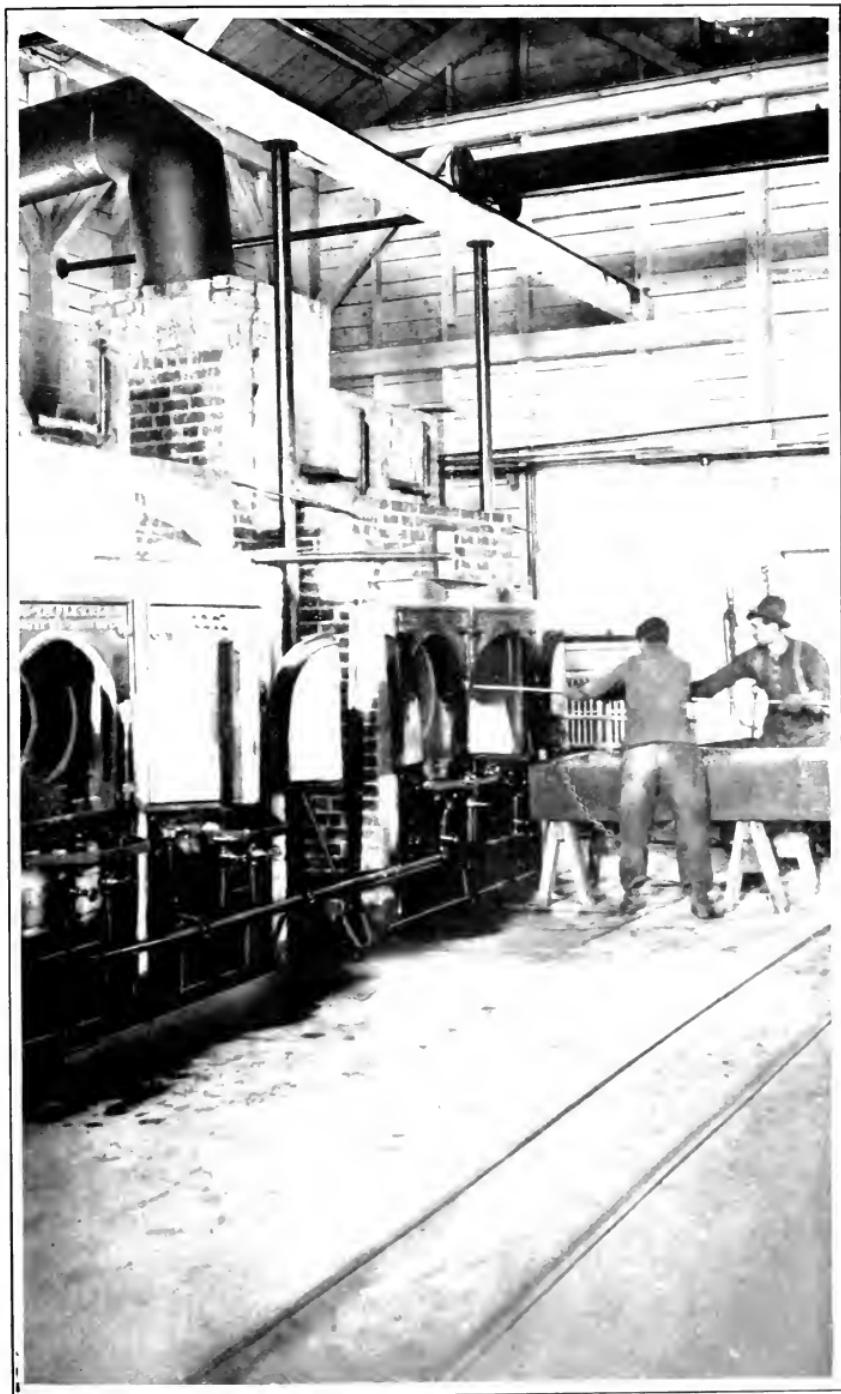
"The materials are charged through a manhole on the top of the mill, and after the cover has been replaced the mill is revolved for 9½ hours, when 99 per cent. of the pulp will pass through a 200-mesh screen. This fine grinding is necessary to liberate the fine particles of silver and permit of complete amalgamation."*

After grinding, the charge is delivered through a sheetiron hopper into an all iron settler, 8 feet in diameter, fitted with wooden shoes. The tube mill is then given two washes with a ton of solution and 1,500 lbs. of mercury, the washes being added to the charge. The settler is then filled with solution and the charge is

*R. B. Watson, General Manager Nipissing mine, in the E. & M. J., Dec. 7, 1912.



Settler, Clean-up Pan, and Canvas Amalgam Filters for Treating the Tube-Mill Products. Nipissing High-Grade Mill, Cobalt, Ont.



Removing Amalgam Sponge from Retorts for Subsequent Treatment in Reverberating Furnace, Nipissing High-Grade Mill, Cobalt, Ont.

kept in agitation by the muller while the amalgam is drawn off into an iron clean-up pan, and from there into 24 canvas amalgam filters. Each filter is capable of holding 400 lbs. of amalgam. In order to keep the amalgam from sticking in the tube mill or caking under the muller of the settler, it must be kept exceedingly thin, and this is accomplished by adding mercury weighing fifteen times the weight of the silver in the ore. After draining in the sacks the amalgam still carries 78 per cent. mercury.

The tube mill acts as a large amalgamating barrel extracting by amalgamation 97 per cent. to 98 per cent. of the total silver in the ore, the cyanide in the charge keeping the mercury clean. An ore assaying 2,500 oz. per ton is reduced to 50 to 75 ozs. per ton when it leaves the settler.

Cyanidation plays a minor role, as the subsequent treatment of the pulp only deals with 6 or 7 tons of 50 oz. ore daily. The agitation tanks used are flat-bottomed fitted with mechanical agitating appliances. A charge for agitation consists of four tube mill charges or 13 tons of dry pulp with 5 lbs. lime per ton in a 0.75 per cent. cyanide solution. Agitation continues for 36 hours, and a high speed is necessary on account of the high specific gravity of the pulp. After settling the solution is decanted and the pulp run into a Butters filter of 10 leaves, where the remaining solution is recovered. After being washed with weak solution for 2½ hours, the cake is discharged. These residues, which on 9 months' run showed average contents of 9 per cent. cobalt and 4.5 per cent. nickel, are stored for a possible further treatment. The Nipissing Company has already made three shipments of this material.

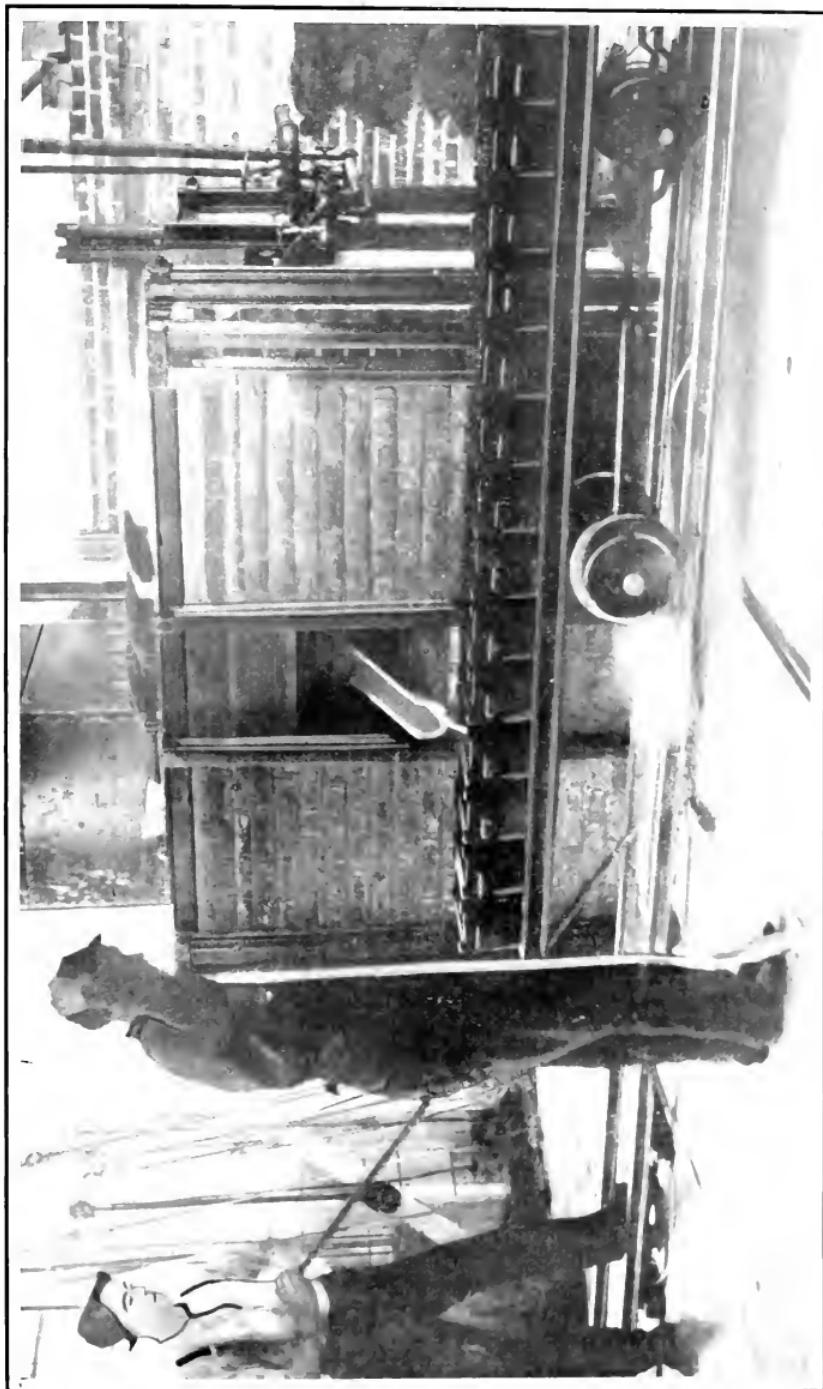
Determination of mercury consumption indicated the presence of mercury in the ore itself. On further investigation it was found that the mercury contents varied in proportion to the amount of metallics in the ore. Twenty-one samples of metallics taken from various Nipissing veins and three other mines showed mercury in every case, varying from 8 to 95 lbs. mercury per ton of metallics, and averaging 35 lbs.

Separate zinc precipitating boxes are provided for the strong and weak cyanide solutions, the usual practice being followed except that the zinc shavings are coarser.

** The precipitate from both boxes goes to an 18-in. Johnson filter press with 12 frames: the press holds 500 lbs. of precipitates which assay 15,000 ozs. silver per ton. The product of the cyanide plant amounts to 8,000 ozs. silver per month.

“The solution going to the zinc box carries 14 oz. silver per ton, 0.028% mercury and 0.6% zinc. By passing through the box the mercury in solution is reduced to 0.015%, so it is necessary to retort the precipitate to recover the mercury. As no solution is thrown away, it has become very foul; after passing through the zinc box it runs to a storage tank in the bottom of which a precipitate collects. An analysis of this precipitate follows: Silver, 0.394%; mercury, 2.51%; Antimony, 3.30%; sulphur, 16.13%; arsenic, 32.64%; silica, 5.362%; zinc, 2.257%; iron, 5.04%; nickel, 9.06%; cobalt, 7.03%; lime, 9.24%; carbon dioxide, 7.259%; manganese, trace.”

The amalgam collected in the sacks is conveyed to the refinery, which is a separate building, and retorted. There are six 14 x 60-in. oil-fired retorts mounted in batteries of two. The charged retorts are fired 9 hours and cooled six. The resulting sponge is 79% silver, the impurities being mainly arsenic, cobalt, nickel, antimony and bismuth.



Oil-Fired Reverberating Furnace for Refining Amalgam Sponge and Bullion. Nipissing High-Grade Mill, Cobalt, Ont.

The retorted sponge is melted and refined in a reverberatory furnace in charges containing 28,000 ozs. of refined silver. When a fineness of 999 is reached the furnace is tapped through the side, the charge filling 25 moulds.

A 20-in. round water-jacketed blast furnace was installed in which is worked up the skimming from the melting furnace, the flue dust and the zinc precipitates from the cyanide plant.

“The only product marketed is fine silver. It is shipped direct to London and is sold at the daily quotation without refining charge. Shipments this year having amounted to 370,000 oz. per month. The bullion carries 0.0043% gold, equal to about \$1 per 1,200-oz. bar. The total cost of the plant was \$67,757, which includes sampler, mill and refinery.”

HIGH GRADE MILL—BUFFALO MINES, LTD.

During the summer the Buffalo Mines erected a mill for the treatment of their high grade ore and concentrates, and the mill commenced operations at the end of November. The method of treatment adopted is very similar to that already in operation at the Nipissing high grade mill.

The ore is hoisted up an incline from the low-grade mill, and discharged into bins near the top of the high-grade mill. The ore is first dried and then ground in a Krupp ball mill through a 30 mesh screen, the metallics from the same being separated during the grinding and sent separately to the tilting furnace. After weighing and sampling, the ore is charged into a 5½ ft. x 20 ft. tube-mill. The charge consists of 5 tons of ore, with an equal weight of mercury with a 40% moisture of a 5% cyanide solution. The tube mill is run until the entire charge will pass 200 mesh, or from 9 to 10 hours. The charge then passes to an 8 ft. all iron settler, from which the mercury is drawn off to a 4 ft. clean-up pan. The mercury containing the silver amalgam is strained in 18 canvas bags, the mercury passing through and returning to the mercury reservoir and the amalgam being taken to the refinery. The ore pulp from the settler, along with the overflow from the clean-up pan is passed into a secondary settler for further recovery of the floured mercury. The overflow from this last settler is run to an elevator and elevated to agitation tanks. These are of the Parral type, three in number, 10 ft. in diameter by 12 ft. high. After sufficient agitation the pulp is drawn off to a 30 ft. Burt revolving filter. The strong solution is filtered into a sump and pumped to a sand filter tank, whence it is drawn off by gravity to the strong solution zinc-box. The overflow from the zinc-box flows by gravity to the strong solution sump, and from there it is elevated by a 2 inch centrifugal pump to the top of the mill to a tank 9 ft. diam. by 9 ft. high. It is then used in the next tube-mill charge. Air is used to drive out the remainder of the strong solution in the Burt filter. A weak solution is then added, followed by a water wash and the cake dried by air. On lowering the pressure in the Burt filter the cake drops off and is wound out by means of an angle iron on the inside acting as a screw conveyor. The cake falls on a 14 inch conveyor belt and is conveyed to a 60 ft. square concrete bin outside the mill.

The pulp in the agitators, after sufficient agitation, is allowed to settle and the clear solution is drawn off by means of a floating siphon to a clarifying press, and thence to the storage tanks at the head of the zinc boxes. Coarse zinc shavings are used to precipitate the dissolved silver. The zinc box precipitates are drawn off into a box with a screen to prevent the escape of any short zinc, and are then

pumped into an 18 inch square frame precipitating press, by a 5 in. x 5 in. Aldrich ball valve pump. The solution is returned to the barren solution sump. Air is admitted to the press at 100 pounds pressure, and the cake after washing and drying is carried to the retorts furnace where it is retorted for mercury recovery. It is then charged into the tilting furnace.

In the refinery the amalgam is charged in four retorts, 14 in. x 60 in., holding 1,000 pounds to a charge. The mercury fumes are condensed and returned to the boot of the mercury elevator. The retorted silver is charged into a refining furnace with a capacity of 30,000 ounces per charge. This furnace also received the silver from the tilting furnace.

The retort, tilting and refining furnaces are all connected with a three-compartment dust chamber, 15 ft. long. One of these compartments contains a coil for heating the air supplied to the refining furnace.

The fumes are carried through a 30 inch pipe containing three water sprays. This pipe is 100 ft. long, and drains to a box in which there is a baffle to prevent the escape of the fumes. This box also serves as a mercury trap. A Buffalo Forge Company suction draft fan with a 24 inch square outlet is placed at the end of the 30 inch pipe and this discharges directly into a 35 ft. stack, 34 inches in diameter.

A well equipped laboratory with a competent chemist in attendance is at hand for mercury, silver, cobalt, nickel and other determinations that are necessary.

By the 31st of December, 1912, this mill had treated 105 tons of concentrates, along with metallics, precipitates and re-smelted bullion, producing 205,302 ounces of fine silver bullion.

Sampling:

The Campbell and Deyell customs sampling works at Cobalt operated continuously during the year. For the 12 months ending 30th September, 1912, 5,604 tons of ore, containing 12,655,150 ounces of silver, were sampled in these works. During the same period about 100 tons of gold ore were sampled.

The ore is crushed in a Krupp ball mill fitted with 8-mesh screens. All metallics coarser than this mesh remain in the mill and are subsequently removed and melted down to bullion. The pulp can then be sampled with a reasonable degree of accuracy. The ground ore is divided into quarters, and each quarter sampled down separately by machines to 1/1,000 of its bulk. These samples are then ground to pass 100-mesh, and divided into the requisite number of packets.

Formerly the dust in these works, which contained a large percentage of arsenic, used to cause skin eruption, decay of the teeth and eating away of the cartilage of the noses of the employees, accompanied by a marked mental inertia. As soon as a man left the environment his health returned in a marked degree. Apparently no antidotes were procurable that were of any avail. Last June a system of suction fans was installed and connected with the different grinding and sampling machines, so that instead of these machines giving out dust, air was sucked into them and the fine dust was conducted to a filtering room where it was caught and the dust-free air returned to the mill. This installation has done away with all the dust difficulties formerly encountered.

FREIGHT RATES ON SILVER ORE.

The freight rates on silver ore over the Temiskaming and Northern Ontario Railway to the smelters in effect on the first of January, 1913, were as follows:

From Cobalt, North Cobalt, Haileybury and New Liskeard, to North Bay

SILVER ORE, CARLOADS, MINIMUM 40,000 LBS.

Below \$49.00 per ton.....	10 cents per 100 lbs.
Above \$49.00 per ton, billed to Canadian points.....	14 " "
Above \$49.00 per ton, billed to outside points.....	16 " "

From Elk Lake to North Bay—

Below \$49.00 per ton.....	11 cents per 100 lbs.
Above \$49.00 billed to Canadian points.....	15 " "
Above \$49.00 billed to outside points.....	17 " "

SILVER ORE, CARLOADS, MINIMUM 30,000 LBS.

Rates in cents per 100 lbs.

From North Bay to

	A	B	C	D
Marmora, Ontario.....	18	20	27	34
Copper Cliff	10	12	16	21
Kingston	15	17	23	29
Orillia	11	13	17	21
Thorold	14	16	21	26
Toronto	12	14	19	24
*Denver, Colorado, U.S.A.	40	46	54	62½

*Denver, Colorado, U.S.A.

APPLICATION OF RATES.

Group A.—Rates apply when valuation is under \$50 00 per net ton.

" B.—	" "	" "	\$50 00 and under \$100 00 net ton.
" C.—	" "	" "	\$100 00 and under \$500 00 net ton.
" D.—	" "	" "	\$500 00 and over per net ton.

When shipments are made to Eastern United States points, a through rate is not quoted, but cars are billed to the frontier, to Buffalo, Black Rock or Suspension Bridge, N.Y. From there new rates and ratings apply.

SILVER ORE, CARLOADS, MINIMUM 40,000 LBS.

Rates in Cents per 100 lbs.

From North Bay to

Buffalo, Black Rock or Suspension Bridge, N.Y., U.S.A.	12½	15	19½	24½
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APPLICATION OF RATES.

Group divisions A, B, C and D apply on same valuation as in previous table.

SILVER ORE, CARLOADS, MINIMUM 50,000 LBS.

Rates in cents per 100 lbs.

From Buffalo, Black Rock and Suspension Bridge, N.Y., to

Bergen Junction, N.Y.	13	16	22	28
Carnegie, Pa.	10	11½	18	25½
Chrome, N.J.	13	16	22	28
Newark, N.J.	13	16	22	28
New York, N.Y.	13	16	22	28
Perth Amboy, N.J.	13	16	22	28

Group A.—Rates apply when valuation is under \$100 00 per net ton.

" B.—	" "	" "	over \$100 00 and does not exceed \$800 per net ton.
" C.—	" "	" "	over \$800 00 and does not exceed \$2,000 per net ton.
" D.—	" "	" "	above \$2,000 per net ton.

* The splitting point for values in the application of rates in the case of Denver is one dollar below that given above, and the minimum carload is 40,000 pounds.

Note:

Shipments are billed at the highest rates (Column D), and charges are collected at destination accordingly. On presentation of paid expense bill and signed assay certificate from the smelter showing the value of the ore to be less than the rating of Group D, charges are adjusted in accordance with the valuation to the above rates. The smelter returns to the mine or owner before deducting transportation charges are the values used in determining the freight rates.

Smelting:

The shipments of Cobalt ores during 1912 were mostly treated by the same smelters as received the production of the previous year. In Canada the bulk of the output went to the

1. Canadian Copper Company, Copper Cliff, Ont.
2. Canada Smelting and Refining Company, Orillia, Ont.
3. Coniagas Reduction Company, Thorold, Ont.
4. Deloro Mining and Reduction Company, Deloro, Ont.

A few consignments were also made to three new plants which commenced operations during the year, viz:

5. Buffalo and Ontario Smelting and Refining Co., Kingston, Ont.
6. Dominion Refineries, North Bay, Ont.
7. Metals Chemical Company, Welland, Ont.

Of the foreign shipments, all went to the United States with the exception of a few high grade shipments from the Crown Reserve mine to the Saxon Government. The American Smelting companies in this market were the

8. American Smelting and Refining Company, at their works at Perth Amboy, Omaha, and Denver, and

9. The Pennsylvania Smelting Company, Carnegie, Pa.

While occasional consignments were taken by the

10. Balbach Smelting and Refining Company, Newark, N.J., and the
11. United States Metals Refining Company, Chrome, N.J.

As most of the Canadian plants produce refined cobalt oxide, the disorganized state of the market for this material has made it impossible at times to profitably dispose of their output, and they therefore welcomed a betterment of the market towards the end of the year.

When the smelters started treating Cobalt ores, cobalt oxide was selling at \$2.50 per pound, but the consumption was so limited that the production from the Cobalt district soon glutted the market. Now the retail price quoted in New York is about 90c. per pound, with an import duty of 25c. per pound. It is selling in England and Europe at from 2s. 3d. to 3 shillings per pound, or about 68c., and the price paid to the smelters is necessarily still lower.

The Canadian smelters now supply practically the entire world's market with cobalt oxide of excellent grade, and if new uses are found for cobalt they are ready to increase the output and supply the demand.

The Canadian Copper Company decided to close down its Cobalt plant and received its last shipment of cobalt ore towards the end of October. Since that time operations have been continued simply as a final clean up to recover the values tied up in ore on hand, residues, furnace bottoms, etc.

The small smelting plant at North Bay is bidding for ore rich in cobalt and low in silver.

The smelting schedules were practically unchanged from those in effect in 1911.

The ores shipped to the smelters will average about 1,000 ozs. silver per ton, between the limits of 75 ounces and 7,000 ounces. A few exceptional shipments are known to have assayed even above this latter figure, the highest shipment recorded being one of 20 tons from the Crown Reserve Mine, which assayed 8,903 ounces silver per ton.

CANADIAN COPPER COMPANY.

The Cobalt plant of the Canadian Copper Company is situated at Copper Cliff, about $\frac{1}{4}$ mile south of the large copper-nickel smelting plant of the same company.

The works were designed to smelt and treat ores and concentrates from the Cobalt silver district, and have been in operation since December, 1905. This Cobalt plant is to be closed down permanently as soon as the values now on hand are recovered.

The following was the method adopted in this plant:—

Treatment:

The ore is first crushed, ground in a ball mill to 30 mesh, and one-tenth cut out by a Snyder sampler. Sampling is completed by coning and quartering. The first quartering divides the sample into two parts, which are worked down as two independent samples. The ore is charged with suitable fluxes in a 30 in. x 72 in. blast furnace, having a capacity of 25 to 30 tons per 24 hours. Limestone from Michigan is used as a basic flux, and low grade Cobalt ore when an acid flux is required.

Products of the blast furnaces are:

1. Silver.
2. Speiss.
3. Fumes containing flue dust, crude arsenic.
4. Slag.

1. The silver button represents an extraction of about 75% of the silver in the ore charged, and assays about 850 fine. The silver is charged into an oil-fired refining furnace, with a capacity of 30,000 ounces refined silver, which brings the grade up to 980 fine. It is shipped in bars to the Balbech Smelting and Refining Company of Newark, N.J., for refining, and sold in New York.

The slag from the refining furnace is a revert to the blast furnace.

2. Speiss: The following is an analysis made of a sample of speiss taken over a month's run:

Silver 900 ounces per ton. Arsenic 24%. Cobalt 27%. Nickel 9%, Copper 2%, Sulphur 6%, Iron 20%.

The speiss is ground to 30 mesh, mixed with 20% salt and roasted in eight mechanically worked Edwards reverberatory roasters, fitted with water-cooled rabbles. Each roaster has a capacity of 2,400 lbs. per 24 hours.

The product or chloridized speiss is taken to the wet house where it is treated in cylinders with water, which dissolves the soluble salts of cobalt, nickel and

copper. Solution is decanted and the copper precipitated on iron. The cobalt and nickel are then precipitated as hydroxides by a solution of soda carbonate, converted to oxides in an oil-fired furnace, ground in a pebble mill, and barrelled for shipment. An approximate assay of this material is as follows:

Silver 15 ounces per ton. Arsenic .3%, Cobalt 40%, Nickel 3%.

Nickel runs lower than the usual proportion of nickel to cobalt for the reason that it is less easily converted to a soluble salt by the above treatment than cobalt.

The treatment of the speiss is continued with four covers of hyposulphite of soda solution, which eliminates all the silver except 20 to 30 ounces per ton. The silver is precipitated from solution as a sulphide by treatment with a saturated solution of sodium sulphide, filtered in a filter press, dried, mixed with 100% sodium nitrate and 10% sodium carbonate, heated to redness in an oil-fired roasting furnace, transferred to leaching tanks where it is leached with hot water. This leaves a spongy mass of metallic silver with a small quantity of cobalt and nickel that has not been changed to the soluble state. The spongy mass which contains from 60% to 65% silver is added to the bath in the silver refining furnaces.

The residues from the first hyposulphite leaching are mixed with quartz and smelted in a blast furnace for the elimination of the iron. The resultant products are:

- (a) Slag.
- (b) Speiss.
- (c) Flue dust and crude arsenic.

(a) The slag, which contains 15 ounces silver per ton, 10% cobalt, and less than 1% nickel, is smelted with other high silver slags with pyrite from Capleton, Que.

(b) The speiss from this second smelting has the following approximate composition:

Silver 300 ounces per ton, Arsenic 25% to 30%, Cobalt 35%, Nickel 25%, with a little sulphur when arsenic is low, Iron 3.5%, Copper 2%.

This speiss is treated as the first speiss up to the time when the first residue leaves the cylinders in the wet house. It then contains about 20% arsenic, and after mixing with 20% sodium nitrate and 10% sodium carbonate, it is given an oxidizing roast in a hand-rabbled reverberatory furnace. This transforms the arsenic to sodium arsenate which is leached out with hot water and discarded. The residue after drying has the following approximate composition:

Silver 20 to 30 ounces per ton, Arsenic .3% to .7%, Cobalt 35% to 37%, Nickel 23% to 25%, Copper 3%, Iron 5%.

Payment is received for the silver in the above product, as well as for the cobalt and nickel oxides.

3. The arsenic from the blast furnace and roasting furnaces is collected in flues and recharged into an arsenic refining furnace. The residue is a clinker high in silver which is returned to the blast furnace. The final product is a refined white arsenic which contains 99.98% Arsenious Oxide (AS_2O_3) with about .3 ounces of silver per ton.

4. The slag from the blast furnace is rejected except when it is found to run over 10 ounces silver per ton, in which case it forms a revert to the smelter.

Power is supplied from the company's plant at High Falls, 11 miles from the smelter. The Cobalt plant requires from 200 to 300 horse-power. Eighty men are employed in this plant, working 12 hr. shifts.

The following statement shows the ore treated and the production of the Cobalt plant of the Canadian Copper Company since the commencement of operations.

Year.	Ore treated. Lbs.	Silver. Fine ozs.	*Metallic		White Arsenic. Lbs,
			Cobalt. Lbs.	Nickel. Lbs.	
1906	1,767,692.5	1,282,692.78	9,021	3,987	.....
1907	4,560,627.5	3,829,542.82	331,151	138,427	510,622
1908	9,857,072.5	8,551,582.07	464,171	268,140	942,827
1909	10,651,189.5	8,779,014.55	690,737	463,588	1,242,722
1910	9,792,511.0	8,696,624.87	346,483	260,756	843,619
1911	6,744,108.0	6,584,102.46	238,684	234,323	680,074
1912	3,667,301.0	3,523,207.80	223,163	209,330	476,156
	47,040,502.0	41,246,767.35	2,303,410	1,578,551	4,696,020

CANADA REFINING AND SMELTING CO., LTD.

The plant of the Canada Refining and Smelting Company is located on property owned by the company, consisting of about 11 acres, situated in the southern part of the town of Orillia, Ont., and adjacent to the Grand Trunk, Canadian Pacific, and Canadian Northern Railways.

Construction was started on the 1st September, 1910, and smelting commenced on the 20th February, 1911.

The plant is designed for the treatment of silver ores from Cobalt, and has a capacity of about 13 tons daily. It produces refined silver, white arsenic, and the mixed oxides of cobalt and nickel.

Treatment.

The crushing and sampling of the ore is done at Cobalt by Campbell and Deyell, samplers and assayers, before shipment to the smelter. The ore is first smelted in an Allis-Chalmers 48 in. circular shaft furnace, which produces.

1. Silver.
2. Speiss (argentiferous).
3. Fumes containing arsenic, silver, etc.
4. Slag.

1. The silver button which represents a silver extraction of about 80 per cent. and assays about 900 fine, is refined in a cupel furnace up to 996 fine and shipped. There are two of these refining furnaces each with a capacity of 70,000 ounces to a charge. The slag from the refining furnace reverts to the blast furnace. Limestone and iron ore are used as fluxes when required, the limestone coming from Longford Quarry, 9 miles distant from the smelter, and the iron ore from Midland, Ont.

2. The speiss is ground, roasted, reground, and sent to the Cobalt house. Here it is treated chemically and most of the metals, except the silver ore, are

* These figures represent the metallic nickel and cobalt contained in crude oxides in which form they are shipped.

dissolved. The impure silver-bearing mud is separated from the liquor in filter presses and recharged in the cupola furnace.

The iron, arsenic and copper are first precipitated from the liquor and finally the cobalt and nickel are precipitated together as carbonates. The mixed carbonates are heated in a hearth furnace and converted to oxides, which after grinding are barrelled and shipped. The oxides assay about 40 per cent cobalt and 25 per cent. nickel.

3. The arsenic fumes from the shaft and roasting furnaces are caught in the impure arsenic bag house, from which the arsenic is taken and treated in resubliming furnaces, where silver is retained in the residue and the arsenic drawn off and caught in the clean bag house, from which it is taken, ground and barrelled for commerce.

4. The slag from the blast furnace is discarded except when the silver contained makes it worth retreating, in which case it is recharged in the blast furnace.

About 300 horsepower is required by the plant. This is supplied by the town of Orillia at the rate of \$18.40 for a 24-hour service per horsepower per year, from a hydro-electric installation 18 miles distant from the town.

The number of men employed at the works will average about 80.

Since the commencement of operations, to Dec. 31st, 1912, ore treated and production has been as follows:

Year.	Ore Treated, Lbs.	Silver, Fine, Ozs.	Cobalt and Nickel Oxides, Lbs.		Value.	Arsenic, Lbs.	Value.
			Cobalt	Nickel			
1911.....	1,635,448	1,719,743	10,825	\$1,796.67	None	None	None
1912.....	3,324,545	3,303,641	79,640	13,477.78	250,088	\$6,639.69	

CONIAGAS REDUCTION COMPANY, LTD.

The Coniagas Mines Limited, of Cobalt, Ont., owns the issued capital stock of the Coniagas Reduction Co., Ltd., except six shares issued to directors to qualify.

The head office of the company is at St. Catharines, Ont., but the smelter is situated at Thorold, six miles west of Niagara Falls. The company's property comprises 160 acres, of which the smelter occupies about four, with a frontage of 1,500 feet on the Welland Canal. It is also served by the Grand Trunk, and Niagara, St. Catharines and Toronto Railways.

Construction of the smelter started March, 1907, and actual smelting commenced May, 1908. Erected originally for the treatment of ores from the Coniagas Mine, Cobalt, Ont., its capacity is sufficient to allow of the smelting of a certain amount of other silver ore from the same district.

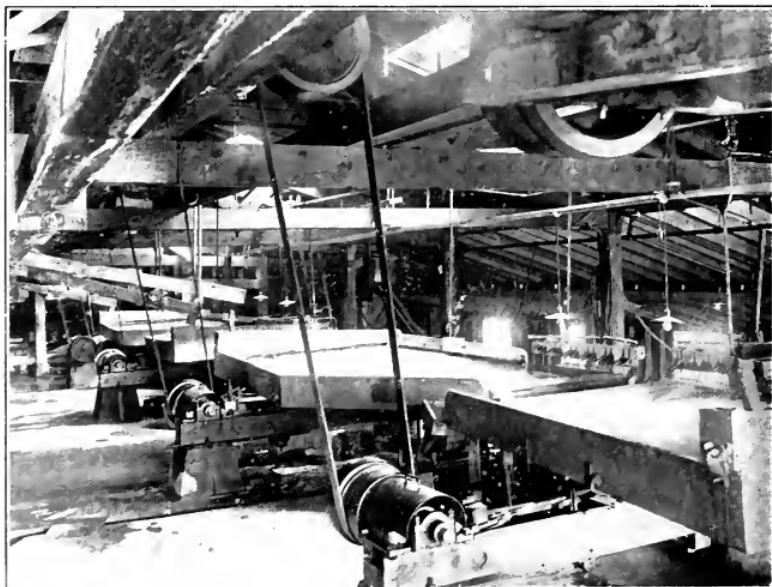
The products of the smelter are silver, white arsenic, and the oxides of cobalt and nickel, either combined or separated.

Treatment.

The ore is first crushed, then ground in a Krupp ball mill, and sampled by a Vezin automatic sampler, two independent samples being made. The fine ore is smelted with limestone, iron ore, and other substances. The separated silver is cast in anodes and refined electrolytically, while the nickel and cobalt are



Sand Table Floor, Coniagás Concentrator.



Part of Slime Table Floor, Coniagás Centrator.

recovered as speiss, which is worked up for nickel and cobalt oxides. These are put on the market either combined or separately.

The combined oxides will assay 40 to 50 per cent. metallic cobalt, and 15 to 25 per cent. metallic nickel, depending on the grade of the ore treated. The oxide of cobalt will run from 60 to 76 per cent. metallic cobalt according to the call of the market, the only impurity being nickel which will run from .5 to 1.25 per cent.

The arsenic fume from the fume and dust flues and collectors is worked up for refined white arsenic, which will assay over 99 per cent. pure.

Power used at the plant is transmitted from Niagara Falls, and the plant requires from 200 to 300 horsepower. The smelter has a monthly capacity of 450 tons of raw ore.

The limestone flux is obtained from Port Colborne, 20 miles distant, and the iron ore from Michigan.

The capacity of the arsenic works is about 1,000 tons per year.

The actual output from the smelter since the commencement of operations has been as follows:

Year.	Ore Treated, Silver, Fine, Tons.	Ozs.	Cobalt Oxide, Tons.	Nickel Oxide, Tons.	White Arsenic, Tons.
1908	266.8	360,683	5.5	1.5	13.5
1909	1,116.9	1,659,604	.9	.....	100.0
1910	2,017.25	3,485,243	53.8	13.2	557.7
1911	2,821.50	5,770,271	60.5	17.3	766.1
1912	2,288.77	4,824,632	129.0	50.7	636.7
.....	8,511.22	16,100,433	249.7	82.7	2,074.0

The smelting schedule of the Coniagas Reduction Co., on the 1st January, 1913, was the same as has been effective since November 1st, 1911, and is in condensed form as follows:

Schedule.

Percentages of silver to be paid for on commercial assay of silver content per ton of 2,000 pounds as follows:

55%	for	50 ounces and proportionate increase in percentage up to	
73%	..	200	..
78%	..	300	..
84%	..	500	..
91.5%	..	1,000	..
92.5%	..	1,500	..
93.5%	..	2,000	..
95%	..	3,000 and over	..

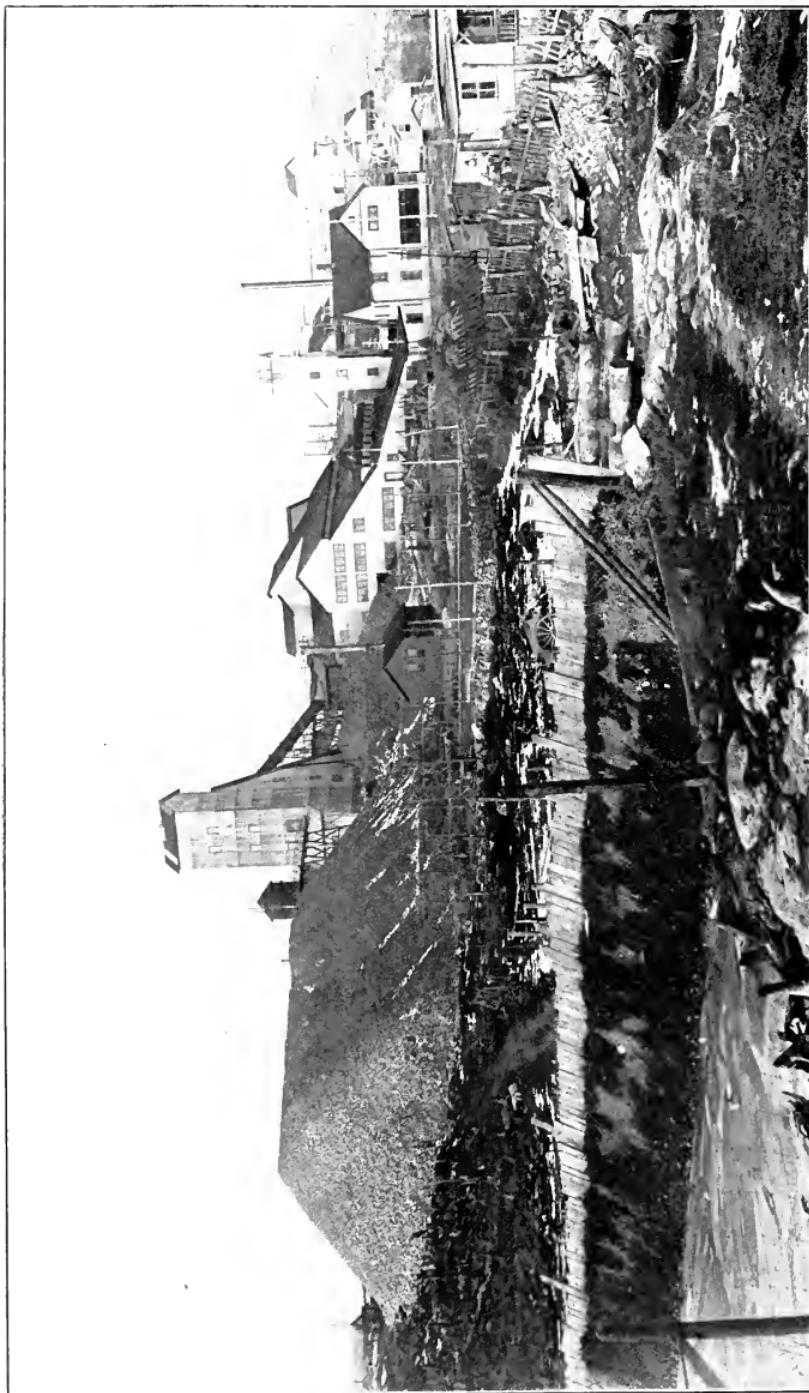
Sampling to be at vendor's expense.

All ore purchased to be at a refining charge of 3½ cent per ounce of silver content.

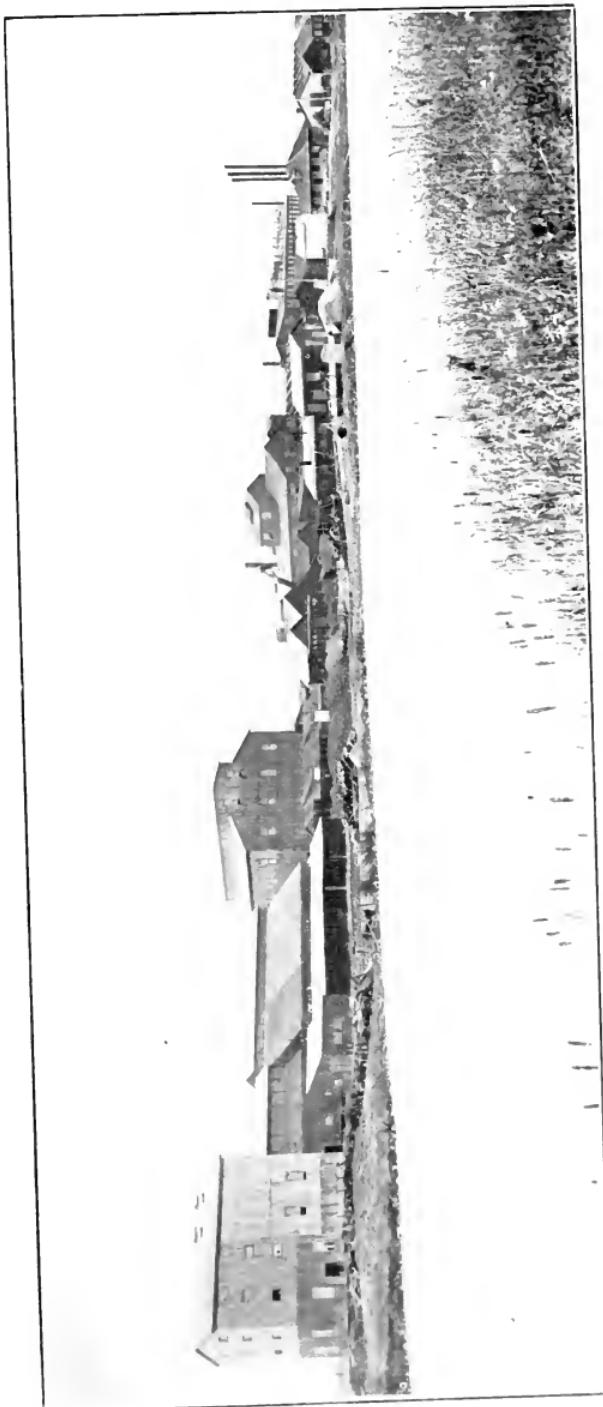
75 per cent. of amount 30 days after date of weighing and sampling reports.

25 per cent. of amount 90 days after the date of said report.

Price of silver to be determined by New York quotation as given by Messrs. Handy and Harman to Western Union Telegraph Company on dates of settlement.



Coniagas Mine, Cobalt, Ont., showing corner of Slime Pond, Rock Dump, Main Shaft House, and Concentrating Mill.



Smelter and Refineries of the Comigas Reduction Company at Thorold, Ontario.

DELORO MINING AND REDUCTION CO.

The Deloro Mining and Reduction Co., is a close corporation, controlled by Mr. M. J. O'Brien, owner of the O'Brien Mine, Cobalt.

The smelter is located at Deloro, Hastings County, Ont., $1\frac{1}{4}$ miles by road from Marmora Station, on the Canadian Northern Ontario Railway. The construction of a railway spur is contemplated early in 1913.

The plant was originally built and operated as an arsenic producer by the Canadian Goldfields, but was entirely remodelled in 1907 by the present owners, to smelt ores from the Cobalt Camp, particularly those of the O'Brien Mine. During the year 1908 a separate and extensive plant was added for the manufacture of cobalt and nickel oxides, and this has been in successful operation since May, 1910.

Treatment.

The ore is first ground fine and sampled by Snyder sampler and hand quartering. It is then charged in a 42 in. Allis-Chalmers cupola furnace producing metallic silver, speiss, slag and argentiferous arsenic fumes. The fuel used is a good grade of coke, and when flux is required a local limestone is used with an occasional addition of a little scrap iron.

The silver button, which is about 850 fine, is charged in a refining furnace, which brings it up to 996 fine.

The speiss is crushed and roasted in mechanically worked roasters, part going to an intermediate treatment and the other part direct to the oxide plant. In the intermediate treatment silver (999 fine) is extracted with cyanide, the residue reverting to the cupola.

The speiss going to the oxide plant is treated so that the cobalt and nickel go into solution. The liquor and residues are separated in filter presses, the latter being returned to the cupola. The cobalt and nickel are precipitated either separately or together. The cobalt oxide (black oxide) after washing, contains 70 per cent. metallic cobalt and under 1 per cent. nickel, while the combined oxides run from 40 to 45 per cent. cobalt, and 10 to 15 per cent. nickel.

The crude arsenic from the cupola and roasting furnaces is caught in arsenic chambers and bag houses from which it is transferred to the arsenic refining furnaces. After refining it is ground ready for commerce as the oxide, white arsenic. The silver-bearing residue is returned to the cupola.

There is usually a considerable slag revert, not only for the purpose of removing any contained silver, but also to assist in the fluxing of the ore.

The smelter has a daily capacity of from 12 to 14 tons of raw cobalt ore. The capacity of the oxide plant is 20 tons per month, but the enlargements that are nearing completion increase this capacity by one-third.

Power is supplied to the smelter by the Seymour Power Co., from Campbellford, over a 22 mile transmission line, at \$20.00 per horsepower. The operation of the plant requires from 300 to 400 horsepower. There are 120 men employed at the works.

PRODUCTION OF DELORO SMELTER, 1908, TO END OF DEC., 1912.

Ore treated	11,065 tons
Silver Produced.....	20,339,860 fine ozs.
Cobalt and Mixed Oxides.....	500 tons.
Refined Arsenic.....	3,275 "

The smelting schedule of the Deloro M. & R. Co., in force on the 1st January, 1913, is as follows:

Schedule.

Pay for 98 per cent. of the silver contents of the ore determined by commercial assay, on the following terms and conditions:

Treatment charge—\$25.00 per ton of ore.

Refining charge— $\frac{3}{4}$ of a cent per ounce of silver contents on ore assaying 3,000 ounces and over per ton. One cent per ounce of silver contents on ore assaying 2,000 to 3,000 ounces per ton. $1\frac{1}{2}$ cents per ounce of silver contents on ore assaying less than 2,000 ounces per ton.

Terms of payment—Seventy-five per cent. of net proceeds at Handy and Harman's New York quotation, 30 days after completion of sampling; twenty-five per cent. of net proceeds at Handy and Harman's New York quotation, 90 days after completion of sampling.

Ore to be delivered in car-load lots f.o.b. Marmora Station, C. O. Railway, and to be at shipper's risk until sampling is undertaken.

COPPER.

Dane.

A test shipment of 20 tons of copper ore was made by the Dane Mining Company, of Dane, Ont., in September, to the United States Metals Refining Company, of Chrome, N.J. This lot assayed 14.56% copper, with a little gold and silver.

Copper prospecting has not yet proved remunerative in this part of Northern Ontario. Some rich pockets of chalcopyrite have been found, but they have heretofore proved small. Recent developments on the property of the Dane Mining Company are considered to be more satisfactory.

Cobalt.

An interesting occurrence of copper is reported by two properties in Cobalt, viz.:—the Drummond and the Temiskaming. Both of these properties have been paid for the copper contents in some of their silver ore concentrates, when shipped to the American Smelting and Refining Co., at Denver, Colorado.

The following is a statement of the copper produced at the Temiskaming Mill during 1912:

Shipping. Tons.	Dry. Tons.	Copper.	Gross pounds.	Gross Value.	Net pounds paid for.	Net Value.
335.0	332.8	2.41	16,037	\$ 2,738	9,381	\$ 1.1

NICKEL.

The Alexo Mine, situated one-half mile from Kilburn, on the Porcupine Branch of the T. & N. O. Railway, is the only operating nickel property in the district.

The shipments from this property during the year were:

May.....	247.85	tons
June.....	211.30	"
Sept.....	294.60	"
Oct.	261.95	"
Nov.....	300.65	"
Dec.....	30.00	"
	1,346.35	tons

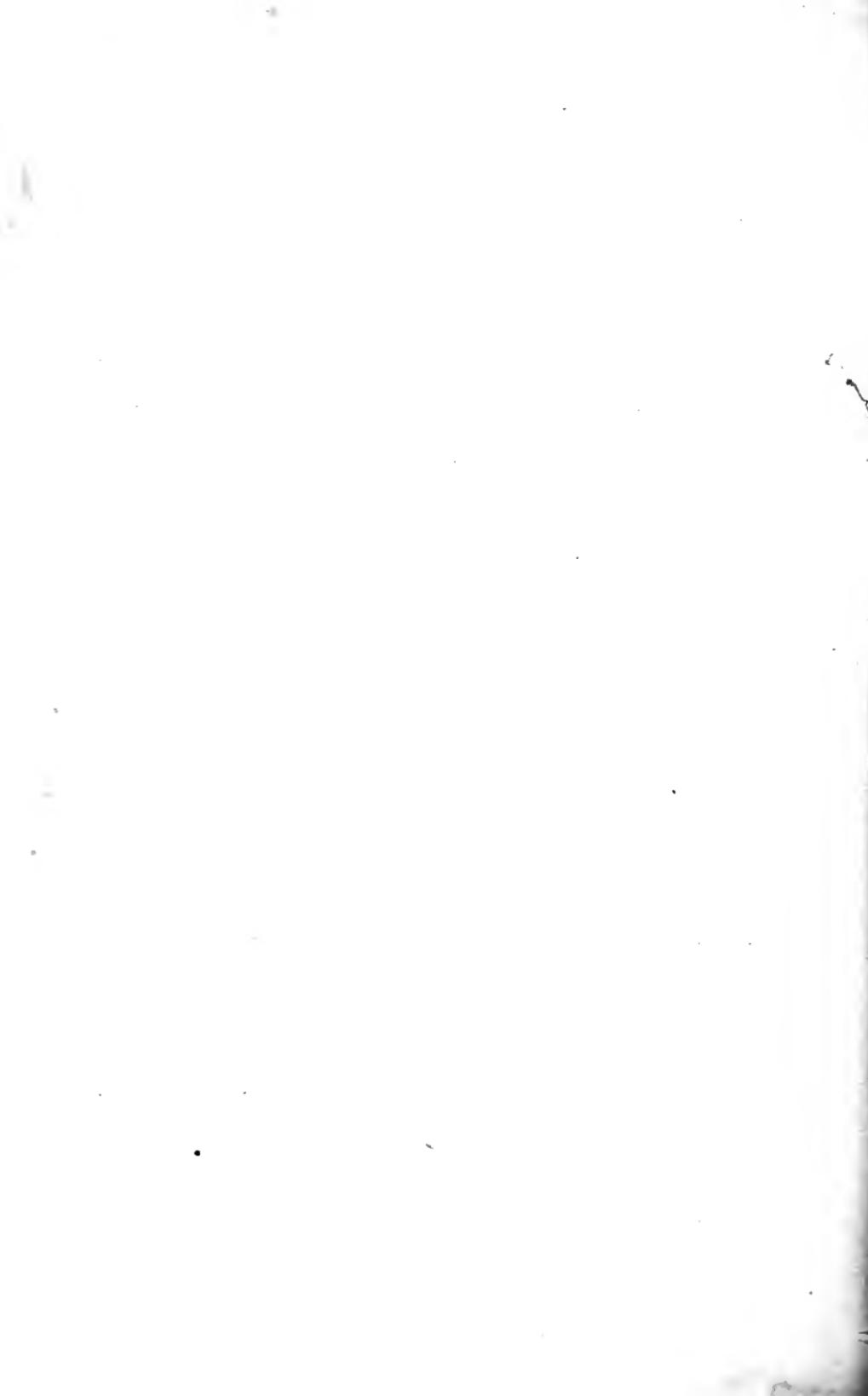
The whole of this ore was consigned to the Mond Nickel Company, of Victoria Mines, Ont. Practically all this ore has been extracted by quarrying or open-cut work.

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The Mining industry in
that part of northern
Ontario served by the
Temiskaming and
Northern Railway

MINING STORAGE



